MECHANICAL ENGINEERING

August 1957

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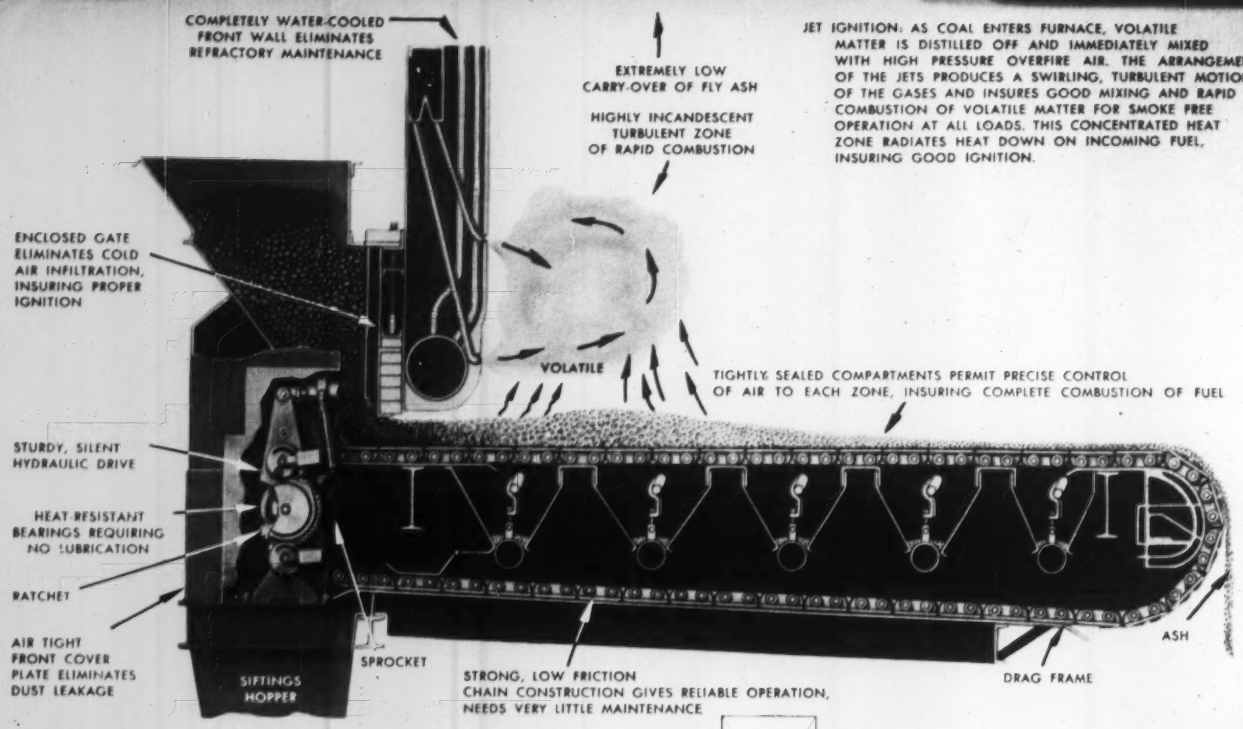
ASME Fall Meeting • Hartford, Conn. • September 23-25, 1957


COMPLETELY WATER-COOLED FRONT WALL ELIMINATES REFRACTORY MAINTENANCE
EXTREMELY LOW CARRY-OVER OF FLY ASH
HIGHLY INCANDESCENT TURBULENT ZONE OF RAPID COMBUSTION
JET IGNITION: AS COAL ENTERS FURNACE, VOLATILE MATTER IS DISTILLED OFF AND IMMEDIATELY MIXED WITH HIGH PRESSURE OVERFIRE AIR. THE ARRANGEMENT OF THE JETS PRODUCES A SWIRLING, TURBULENT MOTION OF THE GASES AND INSURES GOOD MIXING AND RAPID COMBUSTION OF VOLATILE MATTER FOR SMOKE FREE OPERATION AT ALL LOADS. THIS CONCENTRATED HEAT ZONE RADIATES HEAT DOWN ON INCOMING FUEL, INSURING GOOD IGNITION.
ENCLOSED GATE ELIMINATES COLD AIR INFILTRATION, INSURING PROPER IGNITION
VOLATILE
TIGHTLY SEALED COMPARTMENTS PERMIT PRECISE CONTROL OF AIR TO EACH ZONE, INSURING COMPLETE COMBUSTION OF FUEL
STURDY, SILENT HYDRAULIC DRIVE
HEAT-RESISTANT BEARINGS REQUIRING NO LUBRICATION
RATCHET
AIR TIGHT FRONT COVER PLATE ELIMINATES DUST LEAKAGE
SIFTINGS HOPPER
SPROCKET
STRONG, LOW FRICTION CHAIN CONSTRUCTION GIVES RELIABLE OPERATION, NEEDS VERY LITTLE MAINTENANCE
DRAG FRAME
ASH

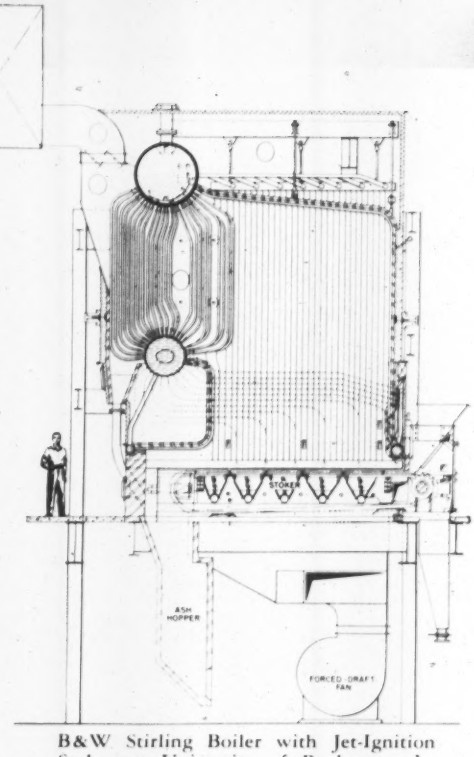
Latest Unit at University of Rochester Will Burn High-Caking Coals

B&W JET-IGNITION STOKER SELECTED TO SOLVE SMOKE AND FLY ASH PROBLEMS

Stable, efficient combustion over wide load ranges, without smoke and with extremely low fly ash, is achieved by the new B&W Jet-Ignition Stoker when burning bituminous and sub-bituminous coals—including high-caking and coking grades. The Jet-Ignition Stoker maintains a clean stack without using dust collectors.

Selection of a B&W Jet-Ignition Stoker for the University of Rochester was made to solve a community relations problem caused by smoke and fly ash. Dr. Lewis D. Conta, Chairman of the University's Division of Engineering, and George D. Haas, Chief Engineer, recommended installation of the unit after observing a commercial installation burning the high-caking coals used by the University.

B&W Jet-Ignition Stokers are another of the developments of B&W engineering and research, supported by nearly a century of experience in all phases of steam generation. If your problem is one of excessive smoking and fly ash emission, Bulletin G-85 will tell you how a B&W Jet-Ignition Stoker can help you. And for any problem in steam generation, B&W engineers are ready to help you and your engineers find the solution. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.



B&W Stirling Boiler with Jet-Ignition Stoker at University of Rochester, designed for 100,000 lb of steam per hr at 125 psi.

G-831-18

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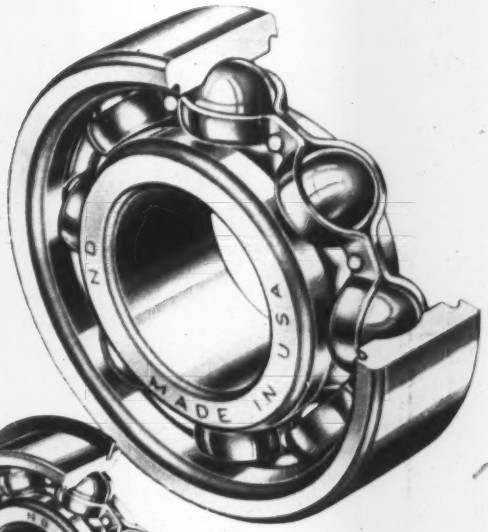
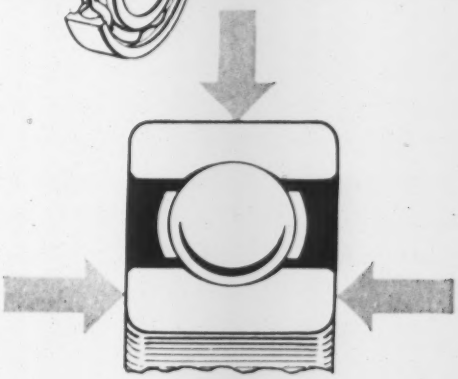
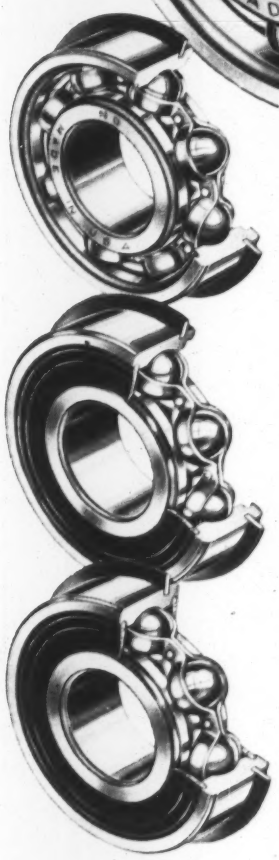
FACTS

about

NEW DEPARTURE BALL BEARINGS







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Fits Like A Glove!

Fits because—this basic New Departure ball bearing, more widely used than any other antifriction type, does much more than carry RADIAL loads—it locates the shaft it supports against THRUST LOADS FROM BOTH DIRECTIONS equally well!

Fits because—with a simple snap ring added, it does away with inside housing shoulders, simplifying mounting and cutting machining costs!

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And—with Sentri-Seals on both sides, this same basic bearing does away with all separate seals, eliminates all need for lubricating fittings—requires no attention for greasing!

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So, specify New Departures of the type that assures you maximum application proficiency and economy.

BALL BEARINGS MAKE GOOD PRODUCTS BETTER

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONN.

MECHANICAL ENGINEERING, August, 1957, Vol. 79, No. 8. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members $3.50 annually, single copy 50¢; to nonmembers $7.00 annually, single copy 75¢. Add $1.50 postage to all countries outside the United States, Canada, and the Pan-American Union. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

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SEND FOR.. *G.S. technical data, free! See where and how we mass-manufacture Small Gearing to uniformly fine tolerances. Folder contains 23 pictures of Small Gears, plant view, as well as Diametral and Circular Pitch Tables. Ask for your copy on company stationery, please!*

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Improve your product...cut costs... designing with Lukens heads

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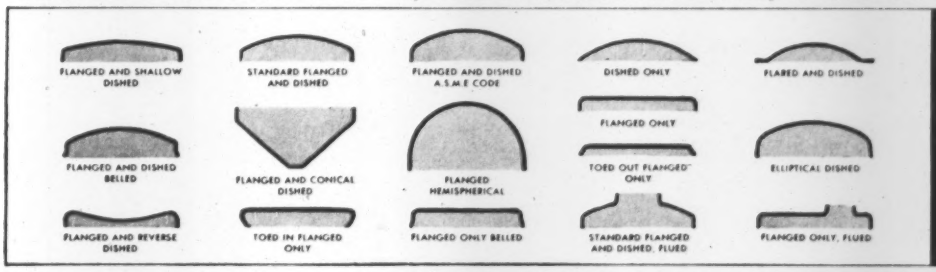

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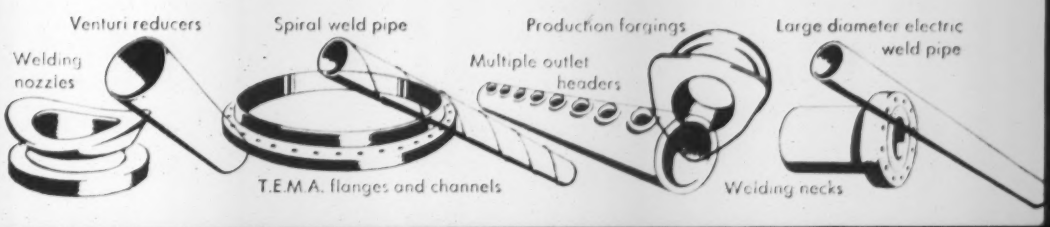
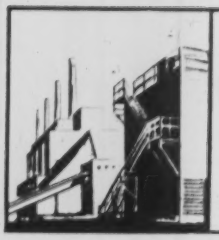


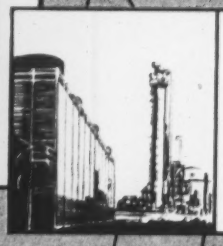
Why 62 NEW FW COOLING

for STEAM CONDENSING and

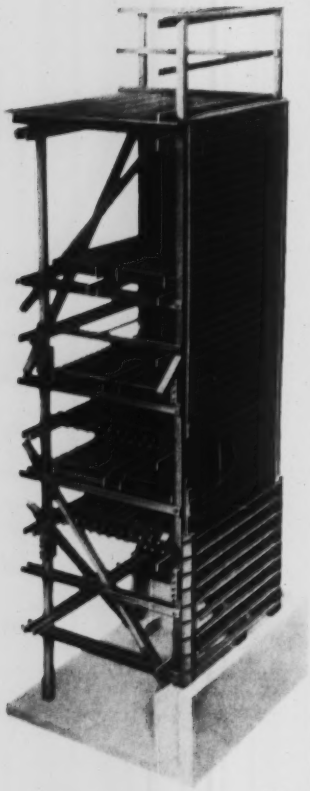
with heat loads from



Steam Condensing Cycle
10 Central Station Units
8 Industrial Plants



Process Cooling Cycle
13 Petroleum Refineries
10 Chemical Plants
5 Steel Mills
3 A.E.C. Plants
9 Miscellaneous



FEATURES IN BRIEF

- Water-Mizer Drift Eliminators engineered for maximum efficiency – hold drift losses well below recommended minimum values.
- Full Cone Spray Nozzles provide maximum dispersion with exceptionally low pressure drop.
- Double Diamond Fill Racks designed to expose maximum water surface to counter-flowing air stream.
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- Ventilated, Double-Wall Redwood Casing keeps outside dry – minimizes wood deterioration.
- Self-Leveling Interior Posts compensate for irregularities in floor and require no piers or anchors.

TOWERS have been specified

PROCESS COOLING CYCLES

25,000,000 to 1,050,000,000 btu/hr

Since the recent introduction of the new Foster Wheeler Induced Draft Cooling Tower, 62 units have been sold in eighteen States and nine foreign countries. Ranging in cooling capacity from 25 million btu/hr to 1 billion 50 million btu/hr, these towers cover a wide range of climatic conditions and geographical locations.

Why were Foster Wheeler cooling towers specified for so many new installations? Part of the answer is given in the list of *FW features* at the left — features that contribute to high cooling efficiency, low drift losses, easier installation and exceptionally low maintenance year after year.

For the *complete story*, send for your free copy of the new, 32-page Cooling Tower Bulletin, CT-57-1, shown at left. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

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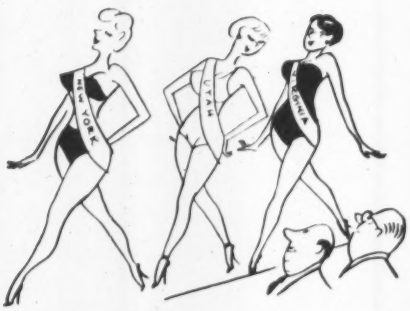
TRYING TO COIL YOUR OWN SPRINGS?

UP AGAINST SEVERE HEAT CONDITIONS?



NEED HELP IN SELECTION OF MATERIAL?

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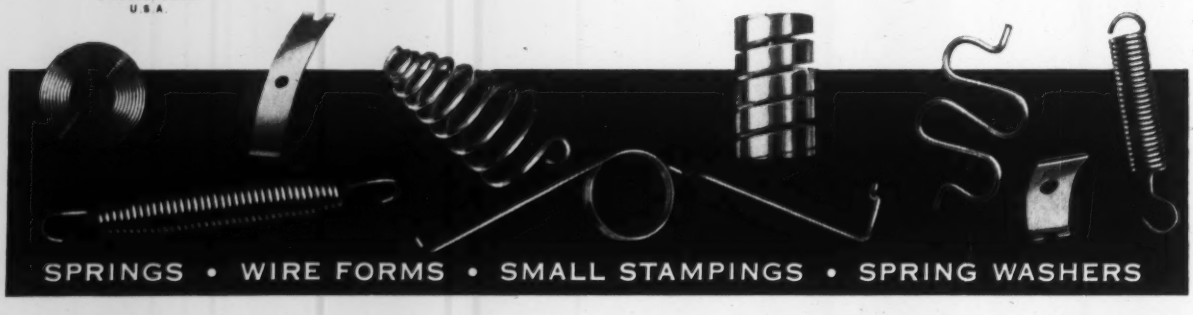

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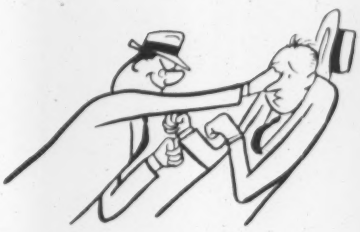
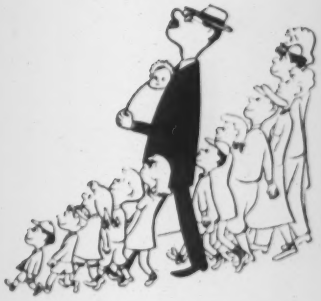
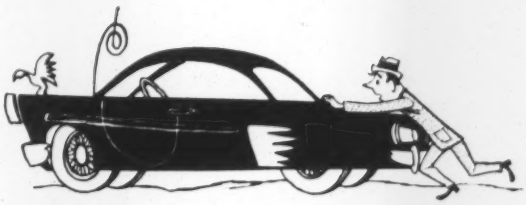
WORKING IN AN UNFAMILIAR ELEMENT?

BECOMING IRRITABLE AT ASSOCIATES?





USING TRIAL-AND-ERROR METHODS?



NEW MODELS CREATING PERFORMANCE PROBLEMS?

NO PROBLEMS? (LUCKY FELLOW)

FIGHTING CORROSIVE CONDITIONS?

HARASSED BY SPACE PROBLEMS?

find the answer here

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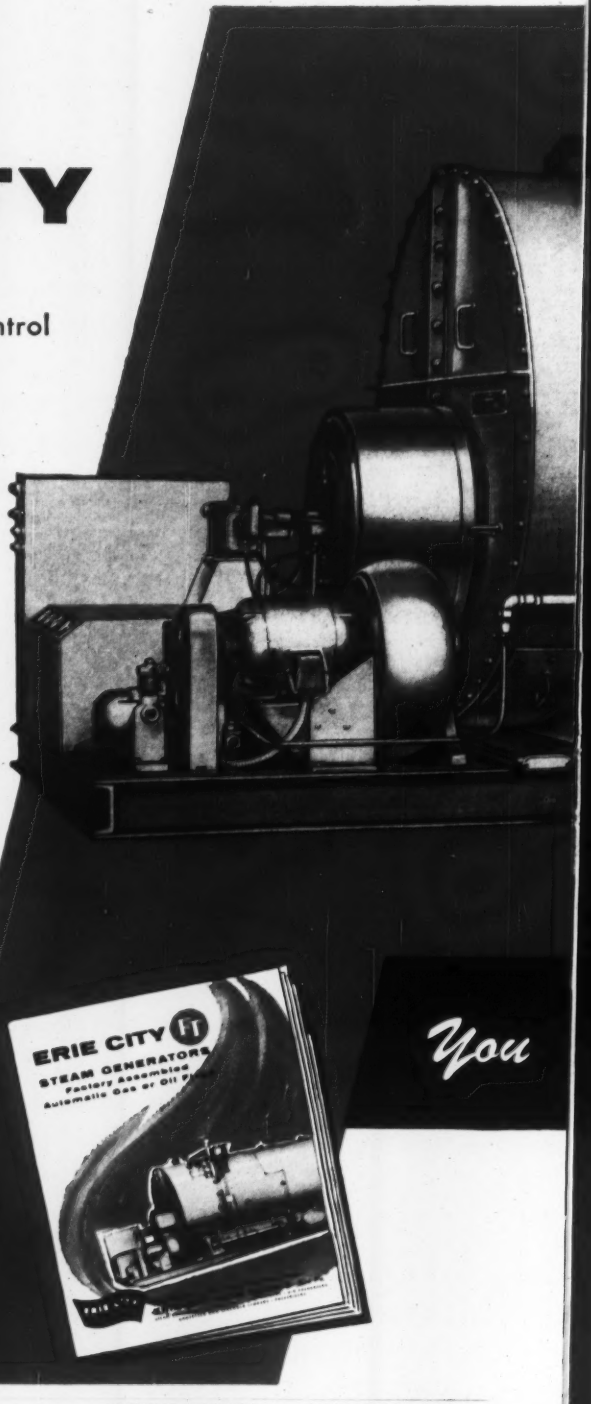


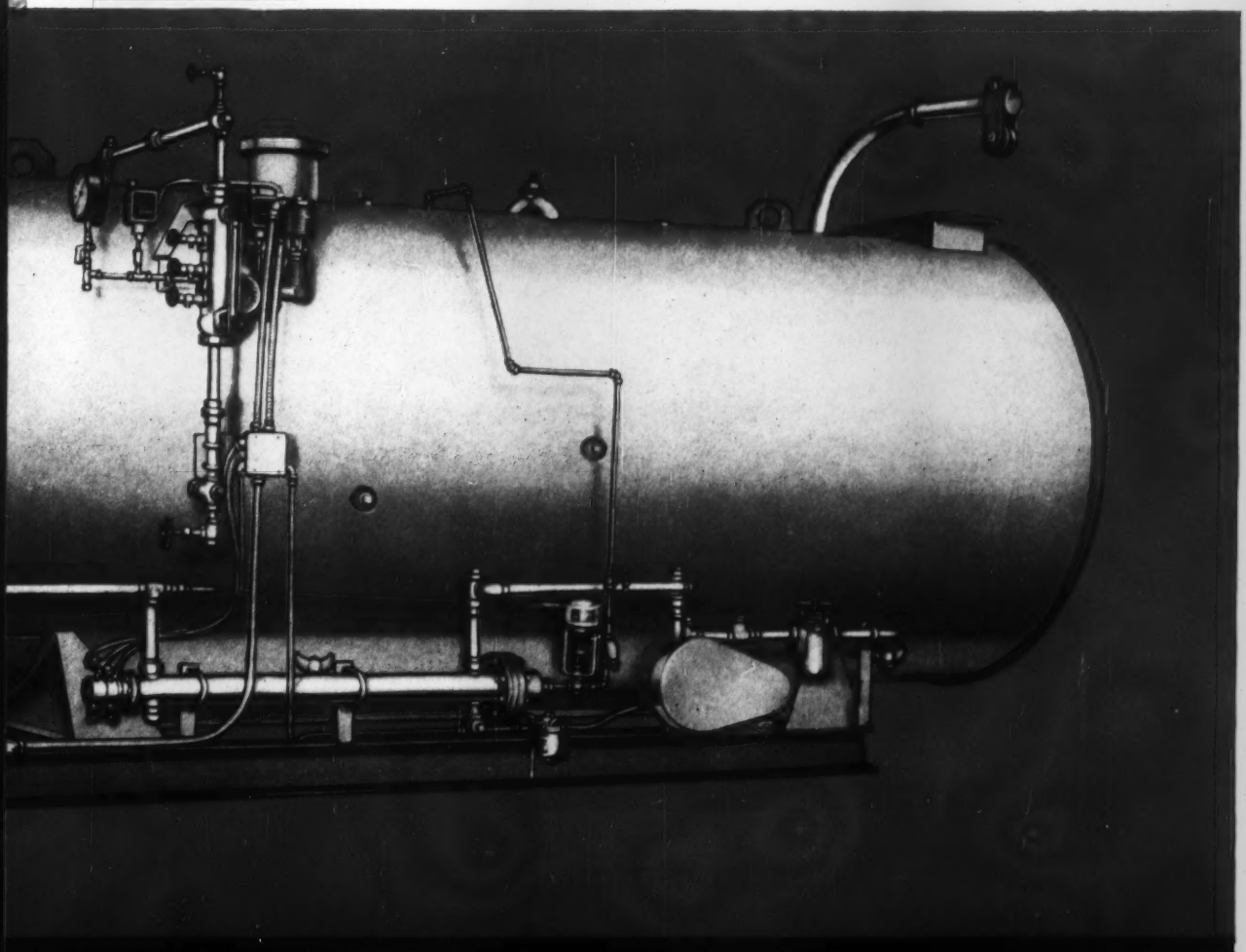
● A truly modern conception of the boiler-burner-control package fire tube steam generator. Manufactured, assembled, wired, piped, and factory fire tested—ready to go to work when it reaches your plant.

Behind this Erie City package unit is the manufacturing skill and engineering know-how acquired through more than a century of producing large, high pressure, water tube and fire tube industrial power boilers.

The FT is conservatively designed, having five full square feet of heating surface per developed horsepower. Peak ratings are easily attainable with no undue strain on the boiler and its attendant high maintenance costs.

For a complete description of the FT write for Bulletin SB-564 H.

1 Responsibility



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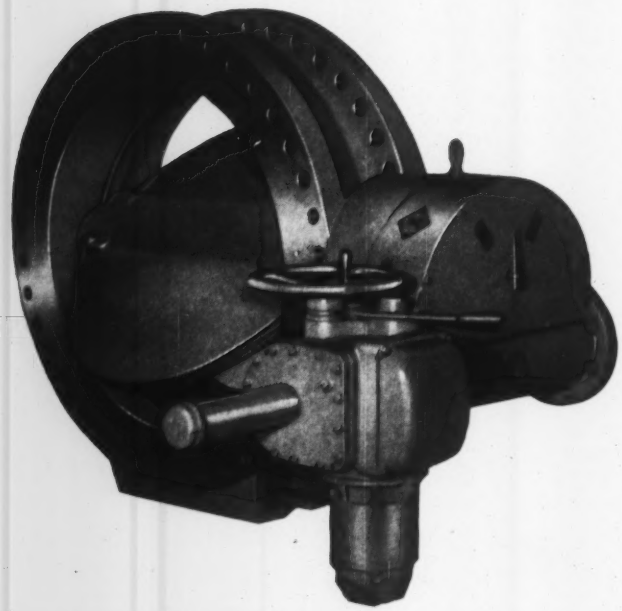


new... valve operator

reduces water hammer

Allis-Chalmers has added a new operator to its line of butterfly valves to reduce water hammer and its harmful high pressure effects.

Especially designed for water works systems, this operator provides rapid initial closing of the valve with slow final closure.

Controlled operation combined with careful construction insures the dependability of A-C butterfly valves.

For details contact your nearby Allis-Chalmers office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

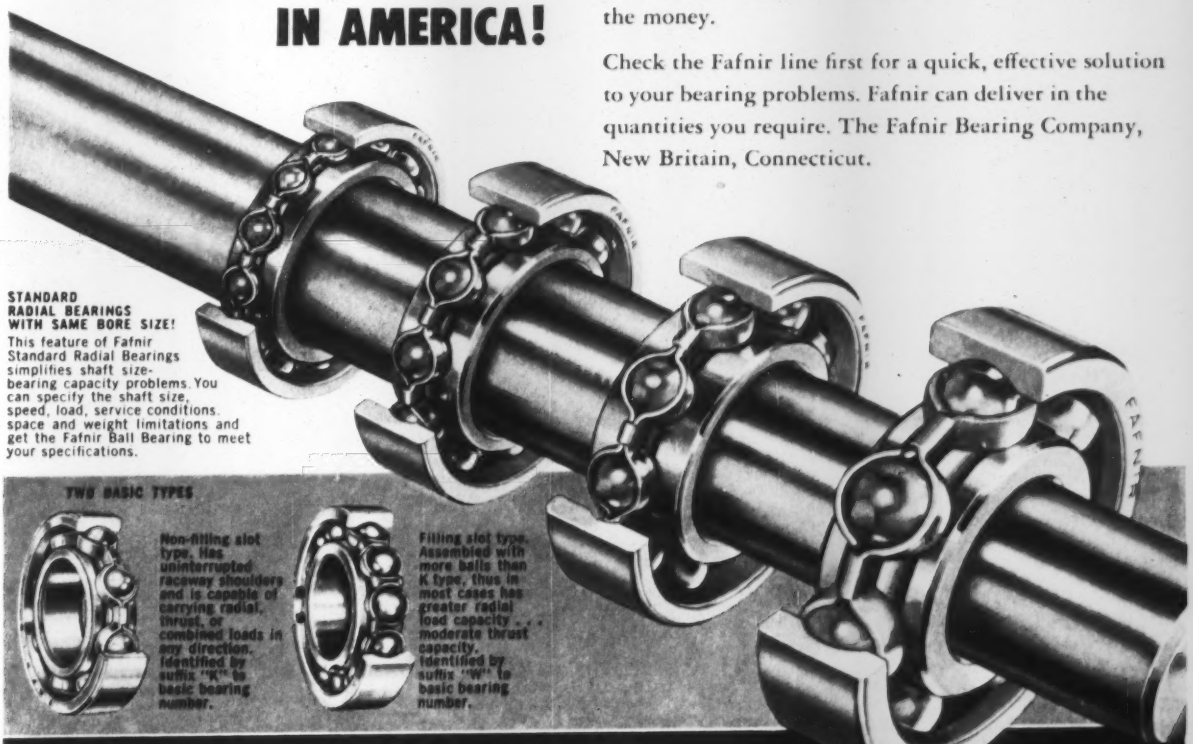
A-5405

For the most effective answers to your bearing problems...

FAFNIR OFFERS THE MOST COMPLETE LINE OF BALL BEARINGS IN AMERICA!

Whatever your bearing needs, your best bet is Fafnir. The reason . . . Fafnir makes America's most complete line of ball bearings, ranging from standard radial to custom-made jet engine types. Various tolerances and combinations of seals and shields enable Fafnir to supply the best bearing for the purpose — the *most* bearing for the money.

Check the Fafnir line first for a quick, effective solution to your bearing problems. Fafnir can deliver in the quantities you require. The Fafnir Bearing Company, New Britain, Connecticut.



STANDARD RADIAL BEARINGS WITH SAME BORE SIZE!
This feature of Fafnir Standard Radial Bearings simplifies shaft size-bearing capacity problems. You can specify the shaft size, speed, load, service conditions, space and weight limitations and get the Fafnir Ball Bearing to meet your specifications.

TWO BASIC TYPES

Non-filling slot type. Has uninterrupted raceway shoulders and is capable of carrying radial, thrust, or combined loads in any direction. Identified by suffix "K" to basic bearing number.

Filling slot type. Assembled with more balls than K type, thus in most cases has greater radial load capacity . . . moderate thrust capacity. Identified by suffix "W" to basic bearing number.

SEALS AND SHIELDS IN A VARIETY OF COMBINATIONS

1 Shield

1 Felt Seal and Shield

1 Mechani-Seal and Shield

1 Plya-Seal

Wide Type Bearing with Plya-Seals

2 Shields

2 Felt Seals

2 Mechani-Seals

2 Plya-Seals

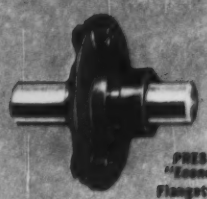
Wide Type Bearing with Mechani-Seals

FAFNIR
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA

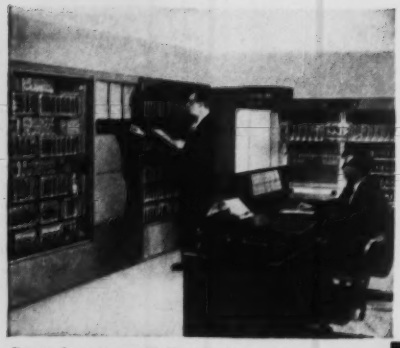
A COMPLETE LINE OF HOUSED UNITS including:

CAST IRON PILLOW BLOCKS
LAK illustrated

CAST IRON FLANGE CARTRIDGES
LCJ illustrated



PRESSED STEEL "Economy" UNITS
Flangette illustrated



Control section of Kellogg's electronic computer.

Electronic Route to Lower Steam Power Piping Costs

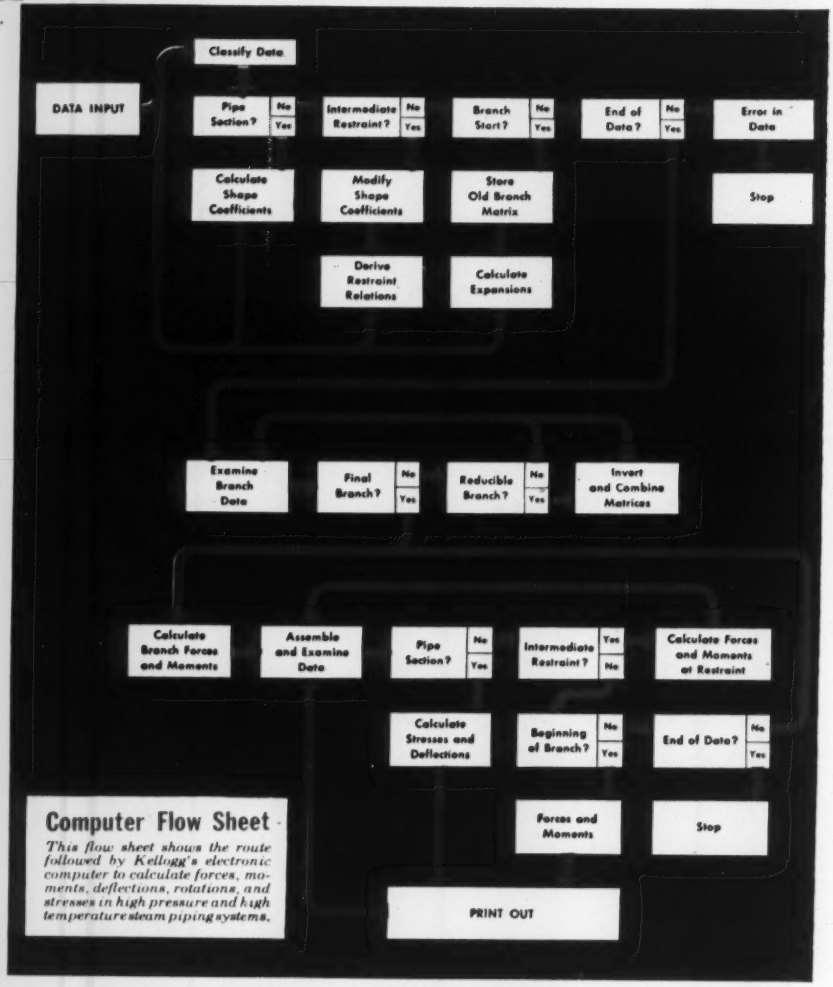
Kellogg's Digital Computer Permits More and Faster Accurate Flexibility Analysis of Complex Main and Reheat Piping Systems

KEEPING PACE with the increasingly critical pressures and temperatures of the modern steam-electric power plant are M. W. Kellogg's advanced techniques for pre-determining stresses and reactions of main and reheat piping. Most recent addition is a large magnetic drum digital computer, used to calculate forces, moments, deflections, rotations, and stresses in complex piping systems.

By enabling Kellogg engineers to undertake a far greater number of calculations in less time than ever before, electronic computation makes possible the ultimate or near ultimate piping system designs. Pipe runs can often be shortened without sacrificing required margins of safety; capital investment and maintenance costs reduced; operating efficiency increased.

A pioneer in flexibility analysis techniques, which include manual calculations, model testing, and a smaller electronic computer, Kellogg continues its pioneering in the power piping industry by the addition of this high speed computer to its New York engineering facilities.

A cordial invitation to see the M. W. Kellogg electronic computer at work is extended to consulting engineers and to engineers of power generating companies and their equipment manufacturers. Appointments may be made through the Sales Manager, Fabricated Products Division.


Classify Data
DATA INPUT
Pipe Section? No Yes
Intermediate Restraint? No Yes
Branch Start? No Yes
End of Data? No Yes
Error in Data
Calculate Shape Coefficients
Modify Shape Coefficients
Store Old Branch Matrix
Stop
Derive Restraint Relations
Calculate Expansions
Examine Branch Data
Final Branch? No Yes
Reducible Branch? No Yes
Invert and Combine Matrices
Calculate Branch Forces and Moments
Assemble and Examine Data
Pipe Section? No Yes
Intermediate Restraint? Yes No
Calculate Forces and Moments at Restraint
Calculate Stresses and Deflections
Beginning of Branch? No Yes
End of Data? No Yes
Computer Flow Sheet
This flow sheet shows the route followed by Kellogg's electronic computer to calculate forces, moments, deflections, rotations, and stresses in high pressure and high temperature steam piping systems.
Forces and Moments
Stop
PRINT OUT

FABRICATED PRODUCTS DIVISION

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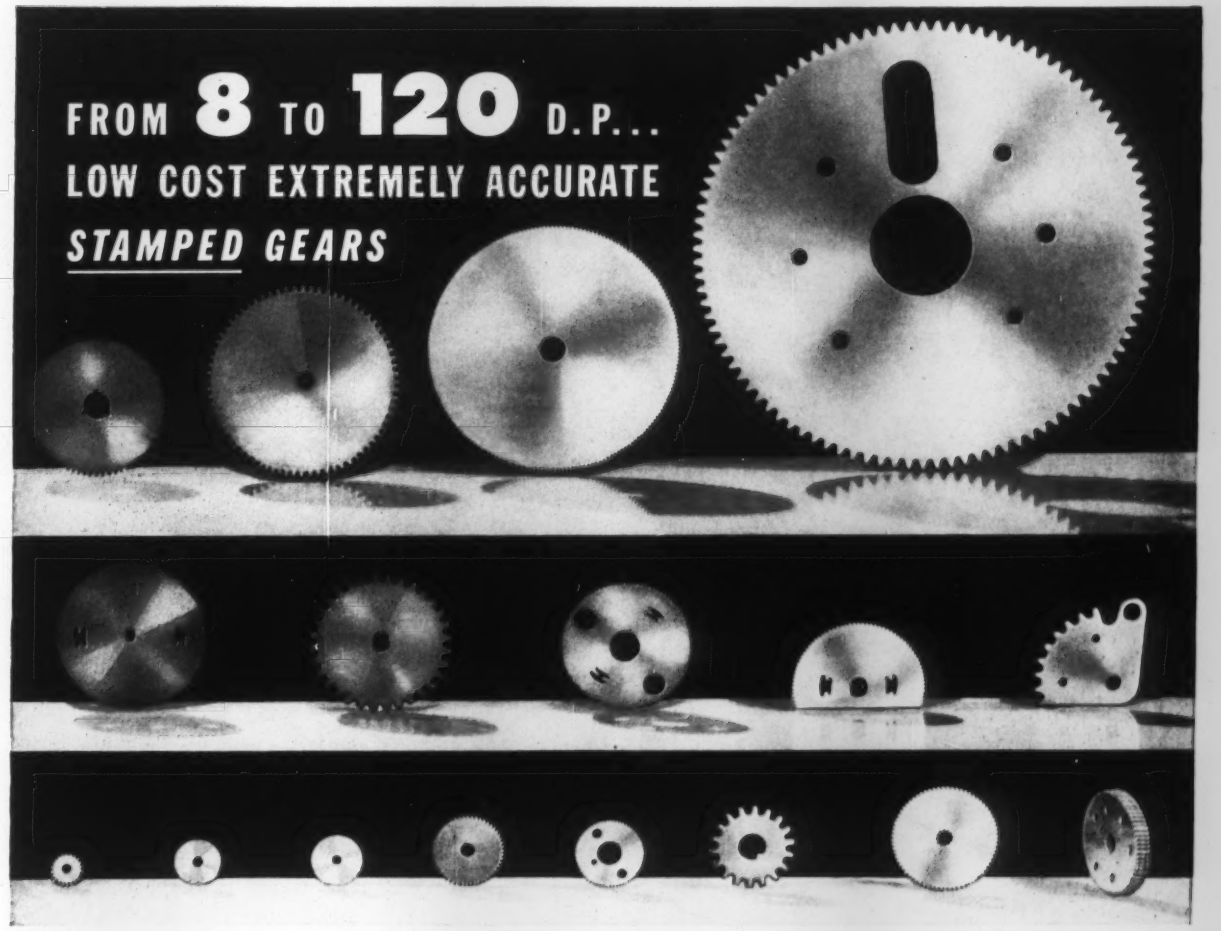
POWER PIPING—THE VITAL LINK



A Wide Range Of Stock Gear Dies Offers You Big Savings!

ACCURATE STAMPED GEARS by *WINZELER* are BIG savers of time and money. For instance, single stampings are often laminated and indexed to form wider faces at savings up to 60%! Further economies are made possible by a wide range of *stock* Dies. And, the *extremely uniform* dimensional accuracy of WINZELER Stamped Gears enables manufacturers to practically eliminate costly assembly downtime.

Modern new plant, methods, and equipment have now greatly increased production speed and efficiency and *economy!* Critical customers from coast-to-coast depend upon us for on-time deliveries of ample quantities to keep production rolling! You, too, can get better WINZELER *Stamped* Gears from 8 to 120 dp . . . from .006 to $\frac{3}{16}$" thickness and up to 7 inch diameter. Send blue prints. Tell us about your needs today. Ideas, suggestions and low cost estimates by our skilled engineers do not obligate you.

SEND FOR NEW LIST OF STOCK DIES!

An up-to-date list of WINZELER-made stock Gear Dies is ready for you now. Ask for a copy, or mount coupon on company letterhead, *please!* All Gears are made in compound dies which insure concentricity and flatness and hold uniform dimension by producing a complete Gear in one station.

WINZELER *Stamped Gears*

MAIL THE COUPON FOR FREE STAMPED GEAR FOLDER AND STOCK GEAR DIE LIST

WINZELER MANUFACTURING & TOOL CO.,
7355 W. WILSON AVENUE, CHICAGO 31, ILLINOIS

Gentlemen:

Please mail to me at once, copies of the free WINZELER Stamped Gear Folder and Stock Die List.

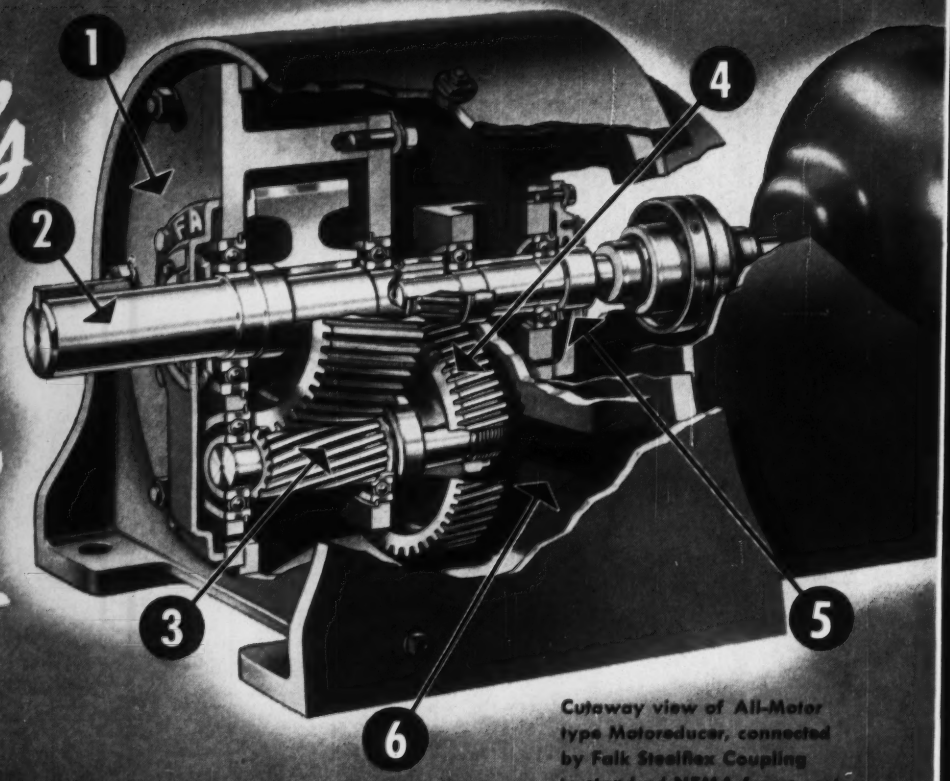
NAME _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE ____ STATE _____

Here's the inside story—



Cutaway view of All-Motor type Motoreducer, connected by Falk Steelflex Coupling to standard NEMA frame motor

WHY Falk Motoreducers give better service—have longer life

Here is the "inside story" behind the all-steel All-Motor type FALK Motoreducer's universal reputation as a gear drive unmatched in quality, efficiency, dependability, ease of maintenance and long life. These "In-built" factors are—

1 **ALL-STEEL HOUSINGS.** Rugged, strong, rigid...all parts are manufactured from heavy steel plate, formed and welded in the Falk Weld Shop.

2 **LARGE OVERHUNG LOAD CAPACITY.** Large shafts, oversize bearings...rigid mountings with wide bearing spans to handle maximum applied loads.

3 **PRECISION GEARING.** Heat-treated alloy steel gearing, precision cut and shaved after heat treatment to eliminate distortion. Quiet, crown-shaved pinions.

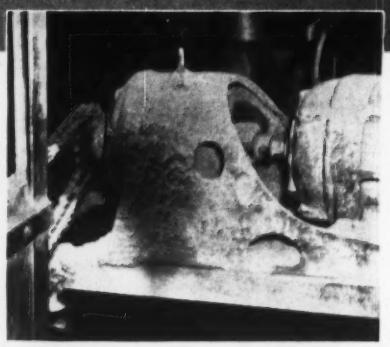
4 **EXTRA-CAPACITY GEARING.** Special extra-capacity gear-tooth form with larger contact area gives greater strength, higher load-carrying capacity.

5 **SEALED HOUSINGS.** Splashproof, dustproof, oil-tight construction. Dual closures and one-way vents keep oil in, dust and moisture out.

6 **POSITIVE LUBRICATION.** Large sump capacity...oiltight construction assures clean lubricant...revolving elements lubricated by direct dip.

When you buy or specify the All-Motor type FALK Motoreducer, you get all these—plus the tremendous advantage of full interchangeability of motors. Switch motors as desired—use any make, style or type of standard foot-mounted motor within the unit's AGMA rating—with a minimum of difficulty or "down time."

Available in sizes up to 75 hp—*with or without motor*—from convenient factory, field or distributor stocks, from coast to coast. **Write for Bulletin 3100.**



60,000 HOURS WITHOUT A FAILURE!

Sixty thousand hours is a lot of hours—but the FALK Motoreducer in the unretouched photo above has served that long without failure or need of repair.

This 3 hp unit is one of over 60 FALK Motoreducers in daily service in an Eastern plant of a large milling company, whose president says, in part:

"One of the main advantages of FALK Motoreducers is their adaptability to any motor. Reducers and motors can be easily interchanged....Our service records confirm the wisdom of our choice of FALK equipment as our standard."

FALK...a good name in industry

THE FALK CORPORATION, MILWAUKEE, WISCONSIN

MANUFACTURERS OF

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
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- Weldments
- Contract Machining

View between the two 2250-ton compressors at Garden State Plaza.

Piping that helps
AIR CONDITIONING
PAY OFF

● Air conditioning has become a giant industry because it provides valuable *user benefits*...more customers, increased working efficiency, greater profit.

Tube Turns is proud to be associated with this growing business, giving it assistance in piping engineering and supplying the top-quality, welded-piping fittings essential for dependable air conditioning systems.

More than 12,000 TUBE-TURN* products are available from your nearby Tube Turns' Distributor for *all* your needs in welded piping of *all* kinds.

AIR CONDITIONED. Buildings alone for the new Garden State Plaza Shopping Center at Paramus, N. J., cover 10 acres. Two 2250-ton compressors provide for the air conditioning system. All welded piping with TUBE-TURN fittings ranges from ½" to 18" diameter. Architect-Engineer: Abbott, Merkt & Co.; General Contractor: Joseph L. Muscarelle; Mechanical Contractor: Frank A. McBride Co.

*"TUBE-TURN" and "🏛" Reg. U.S. Pat. Off.

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS

LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

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In Canada: Tube Turns of Canada, Ltd., Ridgetown, Ontario • Toronto, Ontario • Edmonton, Alberta

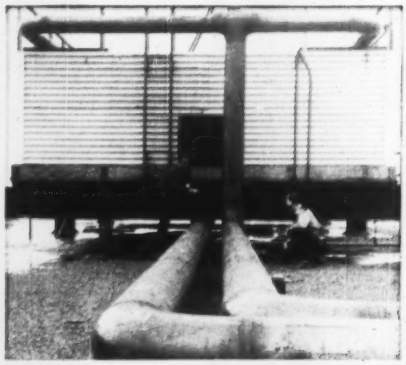
WHY IT PAYS

Why it pays to specify TUBE-TURN® Fittings for

AIR CONDITIONING PIPING

FOR SOUND ENGINEERING. You can specify TUBE-TURN® Fittings and Flanges and *know* you'll get the *right* product, without compromise. For example, you can get TUBE-TURN wrought iron fittings such as used for these condenser water lines in State Capitol Building, Harrisburg, Pa. Contractors: Riggs Distler & Co., Inc.

ELIMINATES GUESSWORK. Workers know they are getting the proper fittings as called for on the blueprint because TUBE-TURN fittings are completely and permanently identified as to dimensions, schedule and material.



FASTER INSTALLATION. Rigid inspection and quality control insure absolute uniformity of TUBE-TURN products...as to size, circularity and wall thickness. Above: Cooling tower for Bergen-Mall Shopping Center, Paramus, N. J. Photos courtesy Frank A. McBride, Paterson, N. J., mechanical contractors.

CUT RED TAPE. Tube Turns' line includes more than 12,000 standard welding fittings and flanges. All are available promptly from your nearby Tube Turns' Distributor. You can fill all your needs with one order to save purchasing manhours. Photo courtesy McJunkin Corporation, Charleston, W. Va.

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224 East Broadway, Louisville 1, Kentucky

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Company Address _____

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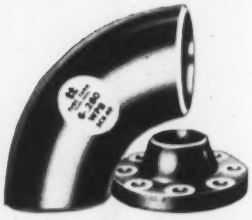
Your Name _____

Position _____

Available now from your nearby TUBE TURNS' Distributor



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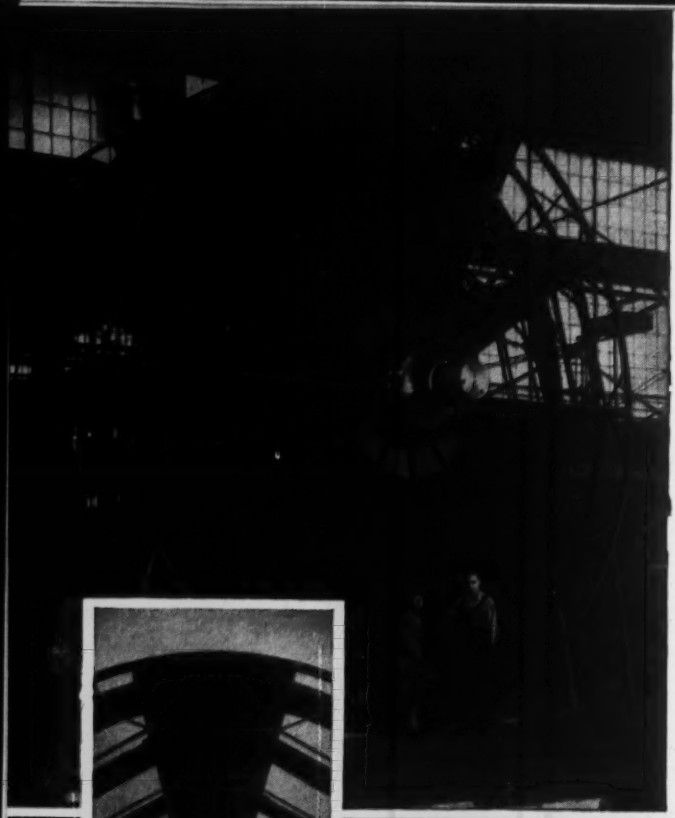
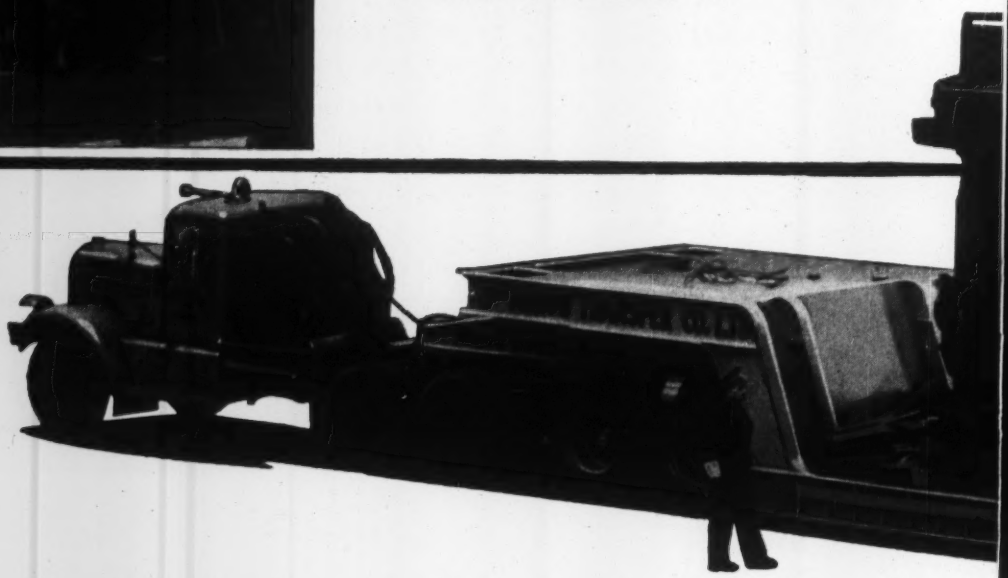


INCREASES CORROSION RESISTANCE. The huge rotor illustrated here is the main structural component of a Ljungstrom Horizontal Air Preheater. Three of these units, designed to serve a 1,900,000 pounds-per-hour-capacity boiler, are among the largest ever manufactured by The Air Preheater Corporation, New York. Each complete preheater weighs 270 tons. The rotor itself—25′2″ in diameter and 10′10½″ deep—when fully loaded with the heating element, weighs about 390,000 lbs.

Because sulfur in the gases combines with moisture—sulfuric acid is formed when the temperature drops below the dew point at the "cold" end of the rotor—corrosive action can be highly severe in this area. Corrosion means maintenance.

Aiming at a reduction in maintenance, the manufacturer cooperated with the U. S. Bureau of Mines in exhaustive tests to determine the corrosion resistance of various materials under sulfuric acid attack in air preheaters. These tests, made over a 5½-year period, showed that the corrosion rate of low-alloy USS COR-TEN Steel was *lower* than all but one of the *high* alloy steels tested, was less than one-half that of carbon steel and less than one-fourth that of cast iron.

As a consequence, USS COR-TEN Steel is specified for the cold end heating elements and containing baskets on all conventional boiler applications. Where unusually severe corrosion is anticipated, USS COR-TEN Steel is also specified in all or part of the rotor including diaphragm plates, bar stock, rim angle and filler plates.



INCREASES DURABILITY, REDUCES COST. Tote boxes have to take quite a beating. Used for handling, storing and shipping automotive and other parts, they must be able to withstand plenty of rough treatment.

That's why the "Hamlintainer" shown here—a *collapsible* tote box that sets up and folds flat in less than 20 seconds—is now built entirely of USS COR-TEN Steel. COR-TEN Steel's greater strength, 50% higher than carbon steel, makes it possible to build the "Hamlintainer" up to 100 lbs. lighter than carbon steel units, yet so strong and rigid that it will withstand long and rugged service and is not susceptible to bending and distortion. The fact that the COR-TEN Steel ends and sides have the stamina needed to permanently maintain their shape is of utmost importance. It means that throughout its long life the box will always be easy to set up, fold and stack flat.

As compared to the metal construction used in an earlier design, USS COR-TEN Steel makes the "Hamlintainer" not only stronger, more rigid and more durable but also less costly to produce, according to the manufacturer, Hamlin Metal Products Co., Akron, Ohio.

UNITED STATES STEEL
USS
HIGH STRENGTH STEELS
1933 1957
24 YEARS OF PERFORMANCE

High-strength USS COR-TEN Steel pays off in equipment like this

What does your product need to make it better? Greater durability? Bigger capacity? Cheaper maintenance? Lower operating cost?

Do you want to make it stronger, lighter in weight, more corrosion resistant, better able to withstand abrasion, impact and fatigue?

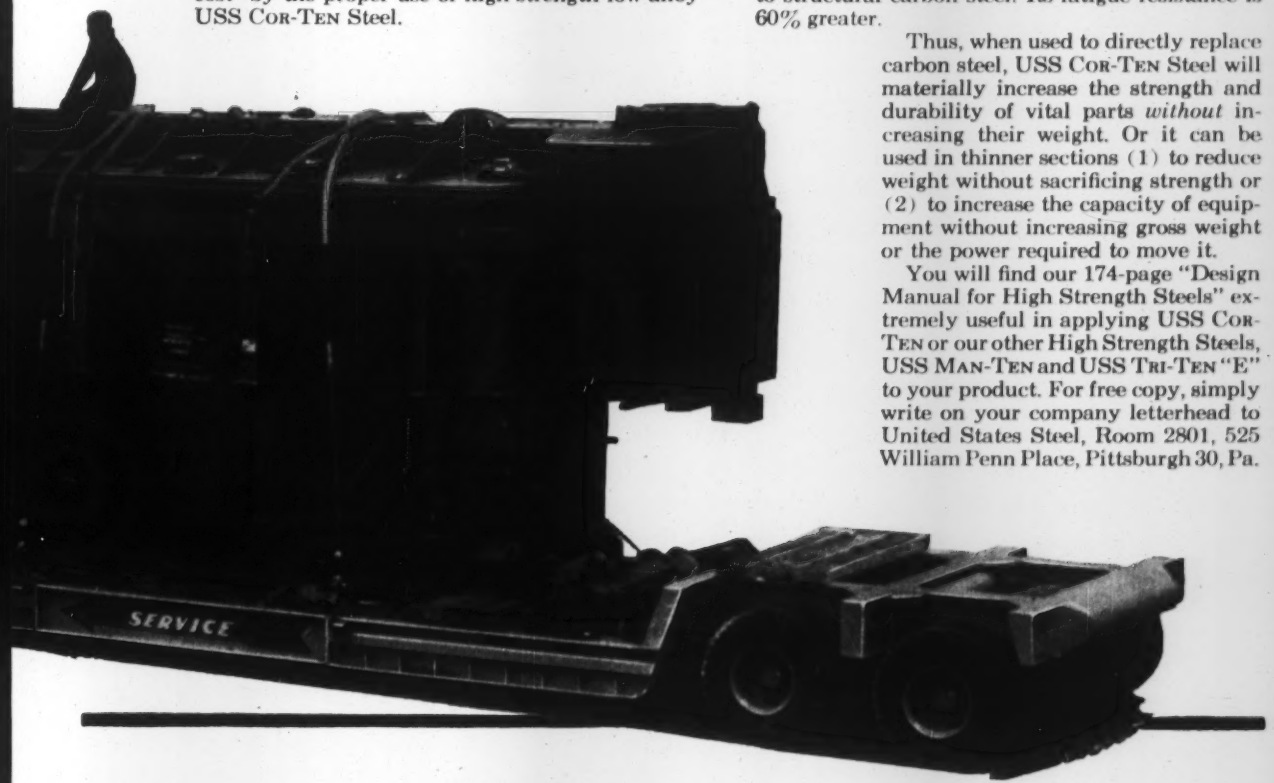
You can obtain any or all of these important money-saving benefits—at little or no increase in cost—by the proper use of high-strength low-alloy USS COR-TEN Steel.

USS COR-TEN Steel is distinguished by its superior resistance to atmospheric corrosion—4 to 6 times that of carbon steel, 2 to 3 times that of copper steel.

In thickness of ½" and under, COR-TEN Steel has a minimum yield point of 50,000 psi and a minimum tensile strength of 70,000 psi. In resistance to abrasion, shock and impact, it is superior to structural carbon steel. Its fatigue resistance is 60% greater.

Thus, when used to directly replace carbon steel, USS COR-TEN Steel will materially increase the strength and durability of vital parts *without* increasing their weight. Or it can be used in thinner sections (1) to reduce weight without sacrificing strength or (2) to increase the capacity of equipment without increasing gross weight or the power required to move it.

You will find our 174-page "Design Manual for High Strength Steels" extremely useful in applying USS COR-TEN or our other High Strength Steels, USS MAN-TEN and USS TRI-TEN "E" to your product. For free copy, simply write on your company letterhead to United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pa.



INCREASES STRENGTH, SAVES WEIGHT. Shown here hauling a 117-ton transformer, this 150-ton-capacity trailer—built by Columbia Trailer Company, Vancouver, B. C., for the Arrow Transfer Company of that city—is the largest trailer ever built in Canada.

This 80-ft.-long trailer is constructed almost entirely of USS COR-TEN Steel. It is about 25% lighter than if it had been built of structural carbon steel. Specifically designed for handling transformers of giant size, it has a depressed center deck which makes loading and unloading easier and keeps center of gravity low to prevent danger of upset.

Says the manufacturer: "We have found that when a trailer is made from structural carbon steel there is a greater possibility that it can be permanently damaged from overloading than in the case of a similar unit made from high strength steels. That's why, in designing trailers of this type, we always use USS COR-TEN Steel. This construction gives us the high strength needed, plus excellent corrosion resistance and freedom from excess weight—all very important in equipment like this."

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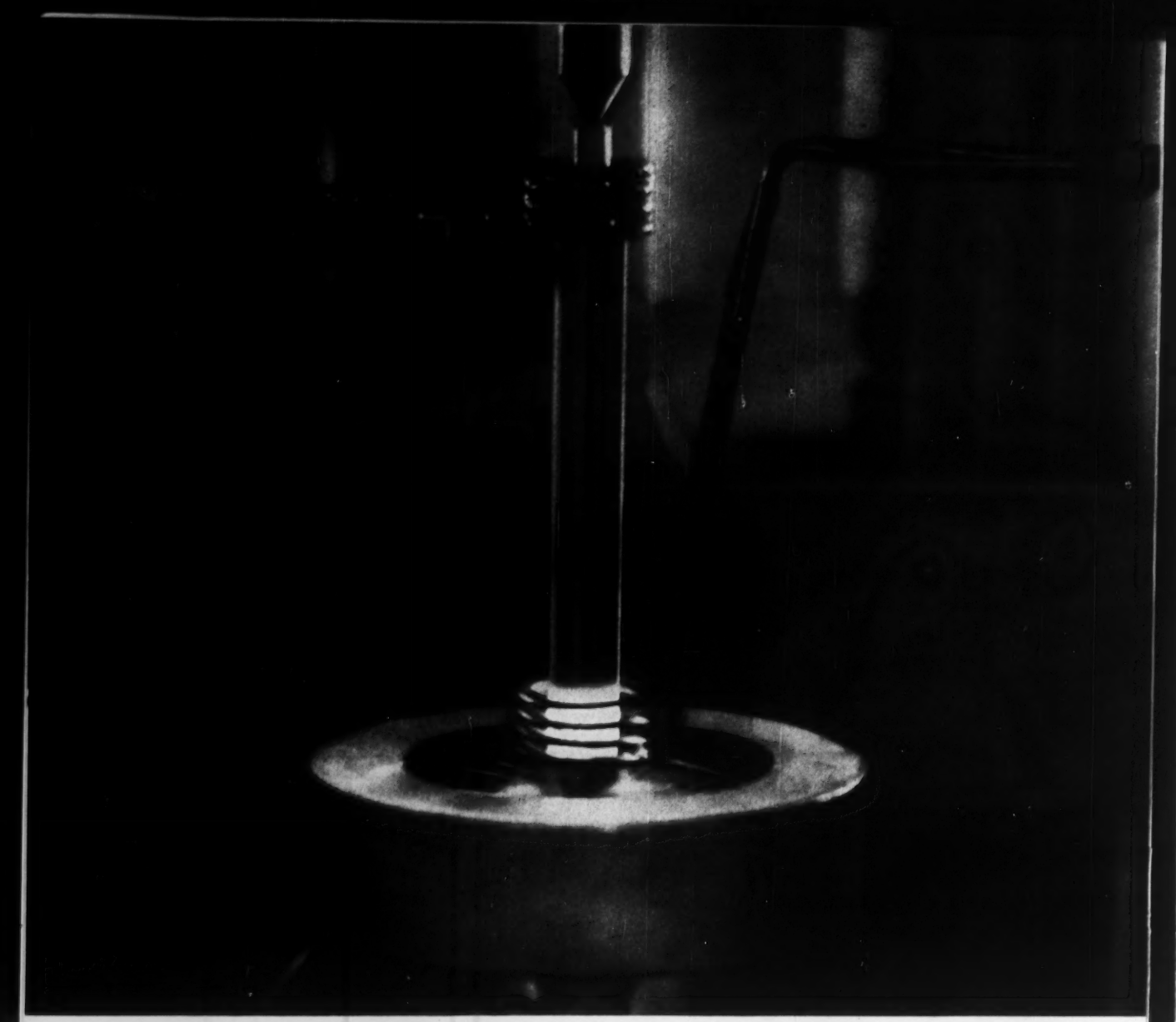
USS HIGH STRENGTH STEELS

USS MAN-TEN • USS COR-TEN • USS TRI-TEN

UNITED STATES STEEL



Ketos shaft being induction hardened to Rockwell 55-56, while ends remain soft for final machining. Photographed at Control Instrument Co., Inc., Brooklyn, N. Y.

KETOS has wide hardening range with minimum volume change...

Ketos is a low priced alloy tool steel that can be hardened from low temperatures with practically no volume change. It has deep hardening qualities, and a fine grained structure, that make it desirable for many production parts.

That's why nondeforming Ketos is well suited not only for most tool steel applications such as gauges, dies, and taps but also for close-tolerance, wear-resistant parts like the actuator bar shown in the induction heating unit above. The thin contact edges of this particular part withstood a "life test" of over 4-million high speed blows. No other steel tested lasted more than 1-million cycles before it chipped and failed.

If Ketos sounds like the steel you should be using, call your nearby Crucible warehouse. Stocks of Ketos and dozens of other special tool steels are large, delivery fast. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

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I-R CONDENSERS AND AUXILIARIES

will serve new, ultra-modern semi-outdoor plant in Arizona

TO SERVE the booming "Kilowatt Country" of Arizona and vicinity, the Salt River Power District is building a new 200,000 kw semi-outdoor steam plant of completely modern design. This Agua Fria Steam Plant, under construction by The Bechtel Corporation, will feature the latest advances in power plant technology, including closed-circuit television for boiler room supervision.

Each of the station's two 100,000 kw turbo-generator units will be served by an Ingersoll-Rand 50,000 sq. ft. rectangular surface condenser. Auxiliary equipment includes I-R condensate and circulating pumps and steam-jet ejectors.

Here, as in all Ingersoll-Rand steam plant equipment, maximum service continuity and long-range *dependability* are primary factors in design and construction. The performance of similar equipment, in leading power plants from coast to coast, has demonstrated its exceptional life-expectancy in continuous, heavy-duty service. Ask your I-R representative for full details on the equipment best suited to your needs.

INGERSOLL-RAND EQUIPMENT FOR THE AGUA FRIA STEAM PLANT —

2 Rectangular Surface Condensers, each 50,000 sq. ft. single-pass, vertically divided.

2 Steam-Jet Ejectors, twin-element, two-stage with surface type inter- and after-condensers.

4 Vertical Condensate Pumps, each a three-stage unit rated 1400 gpm, 250 ft. head.

4 Horizontal Circulating Pumps, each a single-stage double-suction unit rated 41,000 gpm, 57 ft. head.

4-427

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YOUR ONE DEPENDABLE SOURCE FOR ALL THESE VITAL PRODUCTS:

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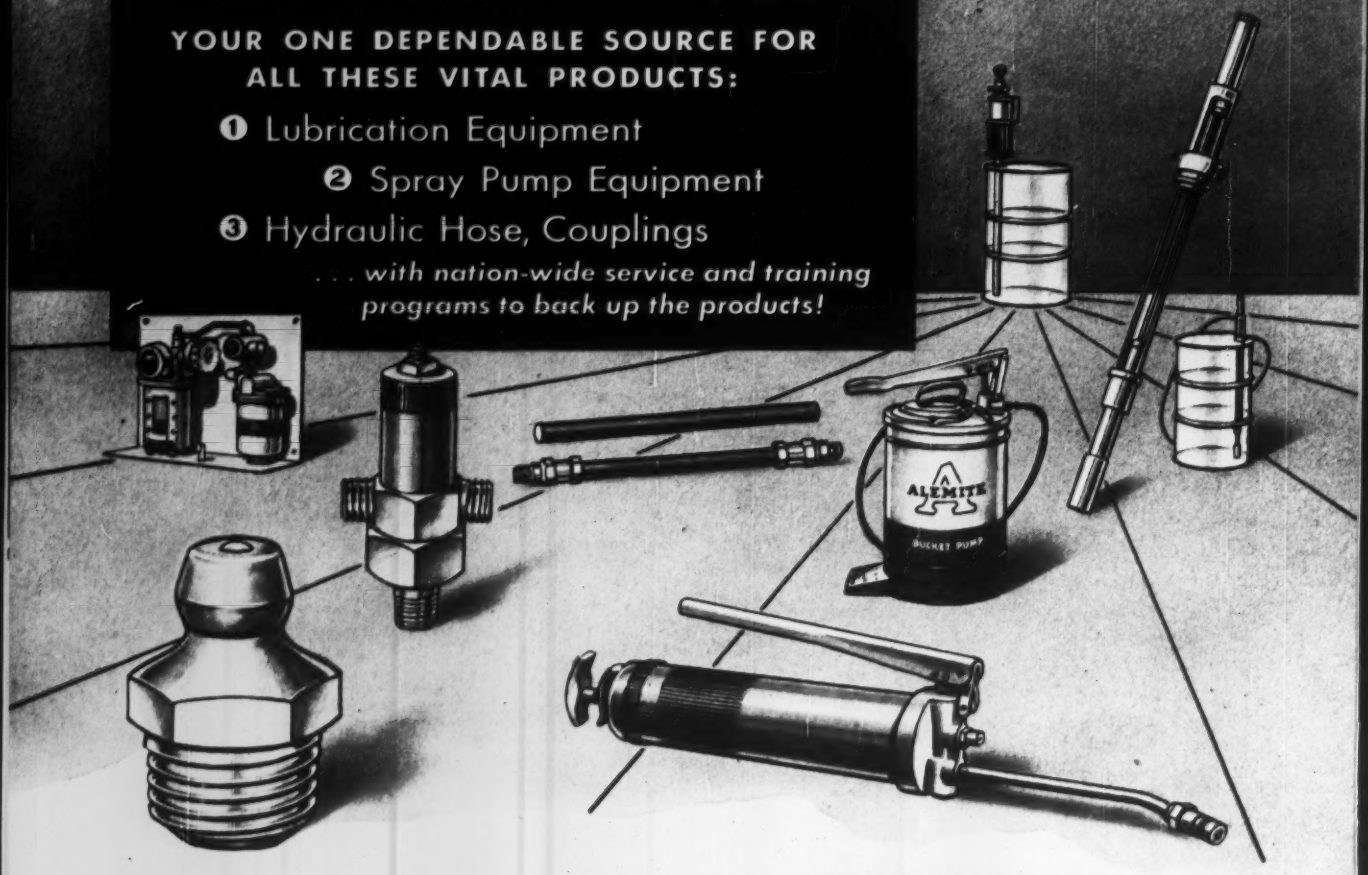
2. Spray Pump Equipment
3. Hydraulic Hose, Couplings

. . . with nation-wide service and training programs to back up the products!



Cut Lubrication Costs up to 64%! Alemite offers the widest choice of lubrication fittings on the market—time-saving pumps and guns for handling of lubricants—fully automatic airborne mist lubrications systems—centralized systems for both oil and grease.

Apply Materials 30% Faster!—If you use any material that is received in a drum—paint, putty, caulking, even food products . . . Alemite can pump direct from the drum to point of application for spraying, extruding, transfering, packaging!

Protect Hydraulic Systems!—Alemite offers a complete line of non-skive, reusable high pressure hose and couplings for *any* hydraulic system.

And Alemite backs up these products with service points from coast to coast—with free training programs and plant surveys that will save money for *your* company!

For free catalogs and complete information, write Alemite, Dept. V-87, 1850 Diversey Parkway, Chicago 14, Ill.

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Division of STEWART-WARNER CORPORATION

Alemite is the only *single source* for all these famous products:

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Accumatic	Centralized Lubrication Systems
red•ball	Hydraulic Lubrication Fittings
"POWERHOUSE"	Barrel Pumps for Oil and Grease
"BARREL-TO-BEARING"	Manual and Power Operated Pumps and Guns
ALEMITE Versatal	Spray Pump Equipment
SURGEPRUF	Hydraulic Hose and Couplings

VICTOR TORCH with cutting tip of Anaconda Tellurium Copper, which has the resistance to heat and wear required to maintain uniform flame characteristics through a long life of service.

Tellurium Copper makes better cutting and welding tips

Two typical Victor torch tips of Anaconda Tellurium Copper-127 shown full size.

THE PROBLEM: Victor Equipment Company of San Francisco first used regular leaded copper rod in making tips for its line of cutting and welding torches. In some applications, however, the leaded copper did not stand up under high heat conditions.

THE SOLUTION: Victor tried Anaconda Tellurium Copper-127 Rod and found the answer. The Tellurium Copper had a much higher heat resistance. This meant long, trouble-free service for its precision-made cutting and welding torches in all types of applications. At the same time, the Tellurium Copper provided uniform machinability, especially important in drilling the deep holes prior to completion by swaging on mandrels.

FREE TECHNICAL SERVICE: No matter what your special problem may be, The American Brass Company can very likely furnish free-cutting copper and copper-alloy rod to meet the requirements of the product or the operation.

It is the function of the Technical Department of The American Brass Company to assist metal users in the selection of Anaconda Rod. This service is at your disposal without charge or obligation. Comprehensive data on composition and machinability of standard Anaconda Rod Alloys, together with specification references, weights and dimensions, are available in Publication B-3. For this booklet – or technical assistance – write: The American Brass Company, Waterbury 20, Conn. 5766

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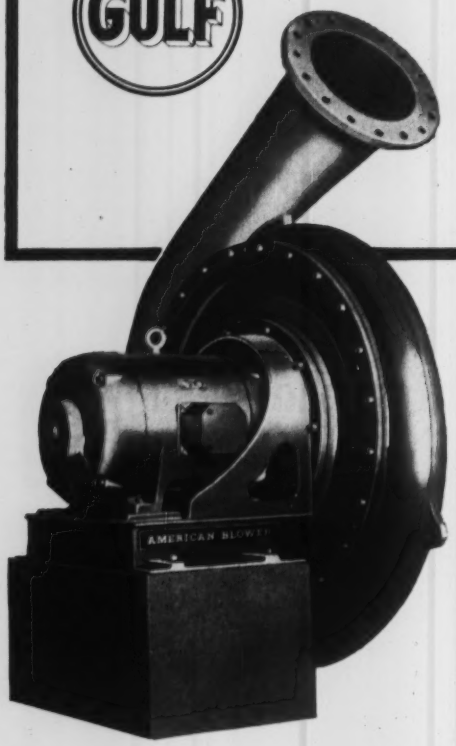

Names make news!

The names? You see some of them above — well-known names in business, whose judgment of a product, its quality and performance, is backed by long and practical experience.

The news? Each of them has selected an American Blower Centrifugal Compressor to handle an important job in their manufacturing process or end product.

American Blower Centrifugal Compressors are available in single-stage sizes — 25 to 2500 hp; pressures from ¾ to 7½ lb. (psig); volumes from 2000 to 140,000 cfm.

If you have an application calling for centrifugal compressors, call our nearest branch for full product information. American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

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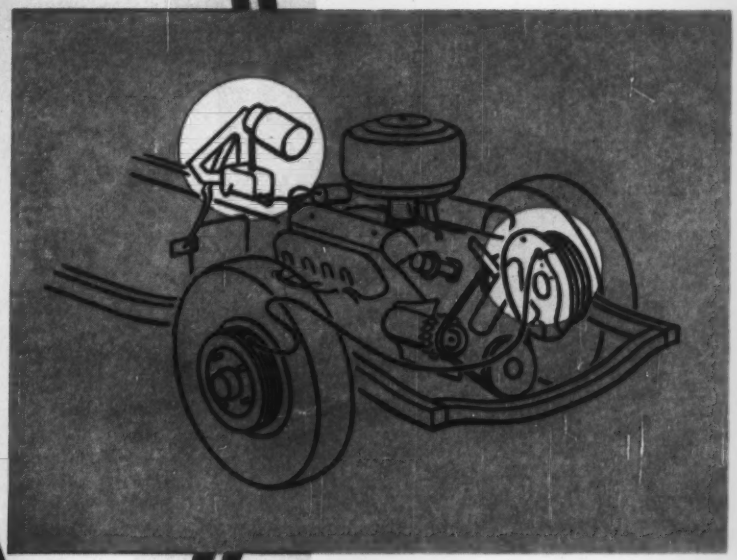
QUALITY PROTECTS YOUR INVESTMENT . . . AMERICAN-Standard QUALITY IS AVAILABLE AT NO EXTRA COST

...for greater safety...LONGER

LINEAR KEEPS THE POWER IN POWER BRAKES
with Roto-Mold "O" Rings



Power brake systems, that stop two tons of automobile with pedal pressures too light to crack an egg shell, require lasting seals of uniform physicals and dimensions—seals that will withstand actuating fluid pressures . . . mechanical wear . . . abuse . . . chemical action of brake fluids and destructive action of improper hydraulic mediums.

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and be sure to specify LINEAR Roto-Mold "O" Rings.

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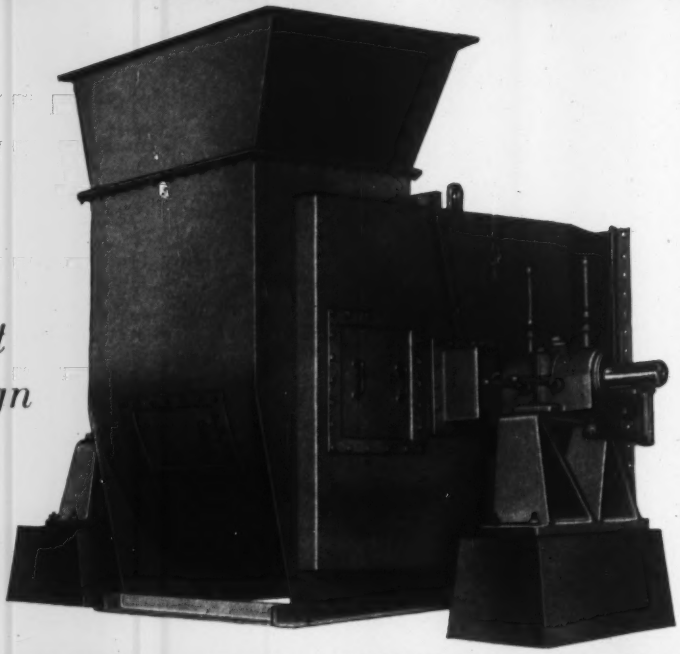

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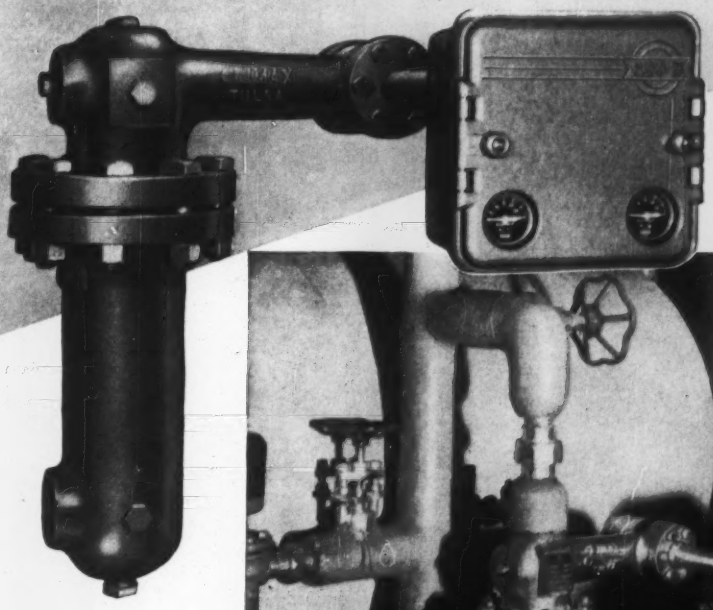
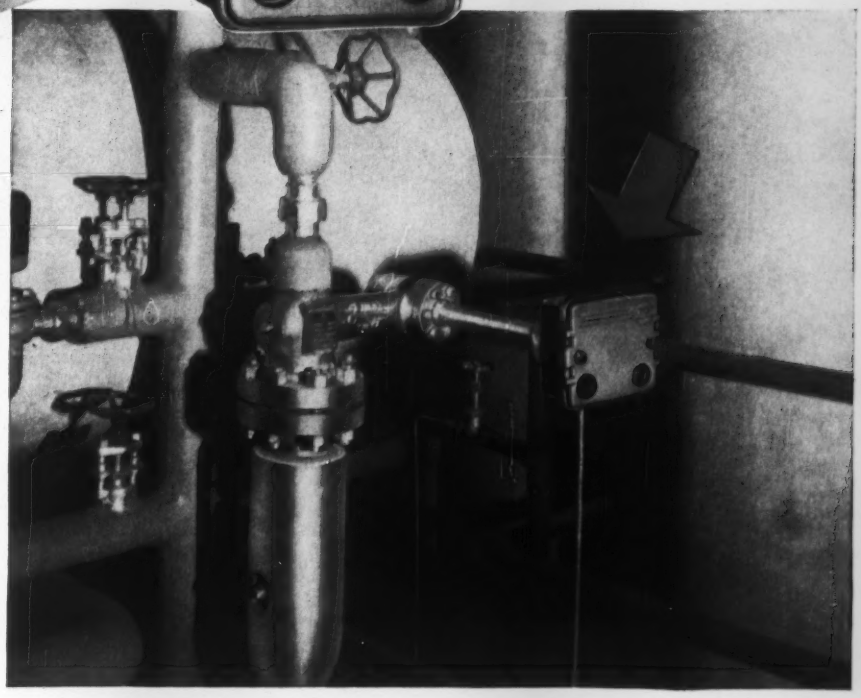


BS&B Type 71-06, Series 2!



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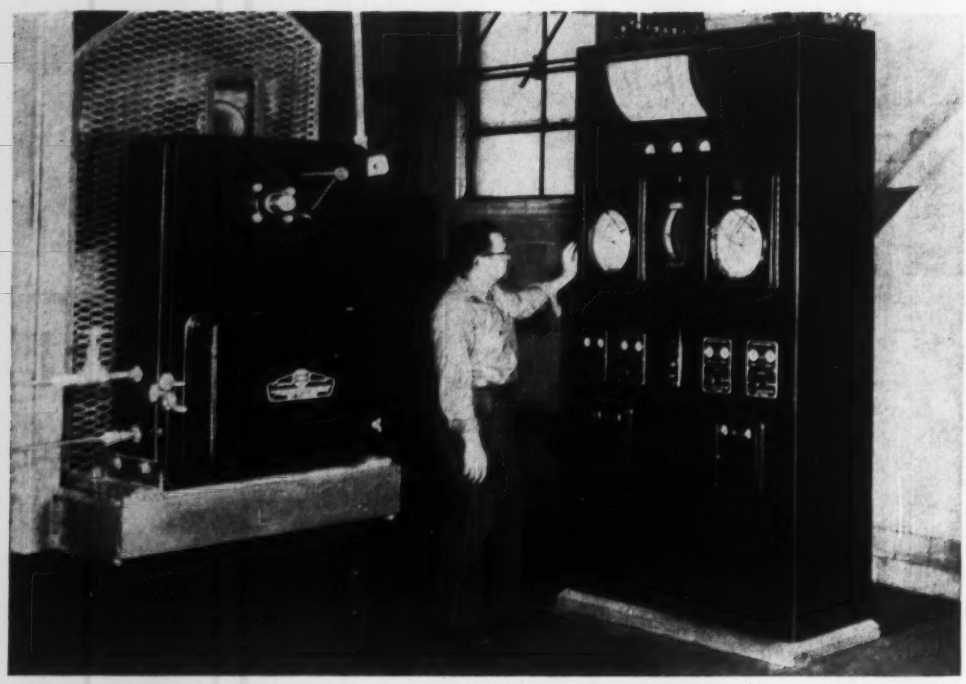

This Bailey Control System helps cut fuel costs on a 70,000 lb per hr capacity 125 psi boiler in an industrial plant. Control drive in foreground regulates stoker.

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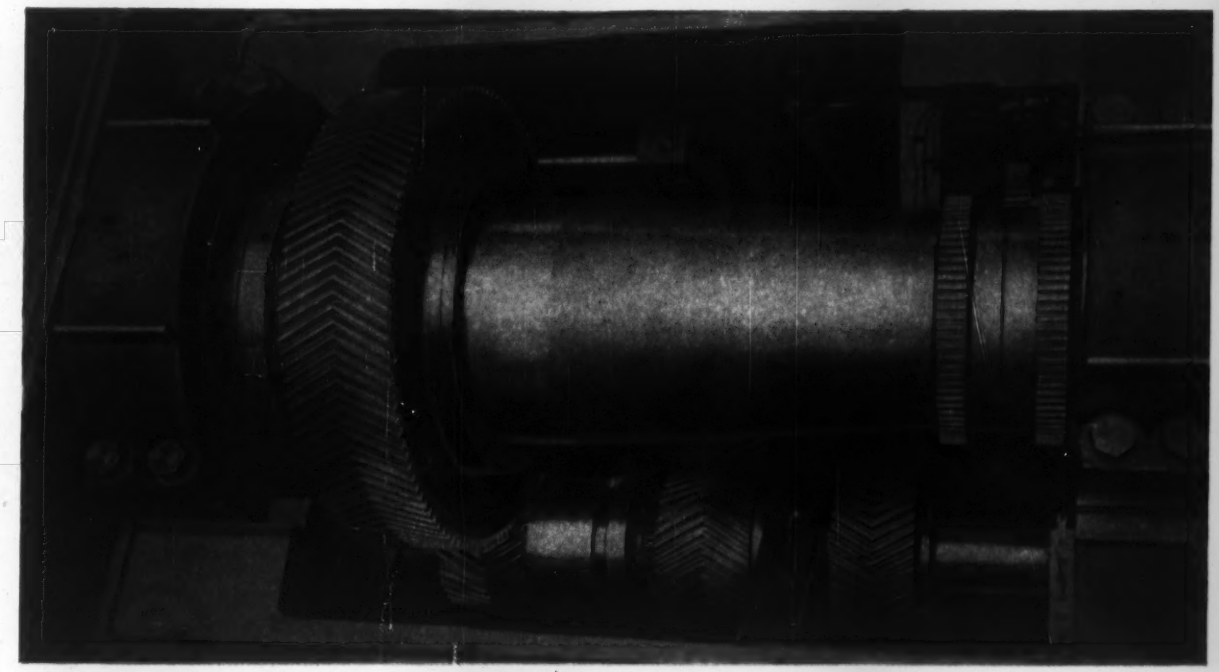
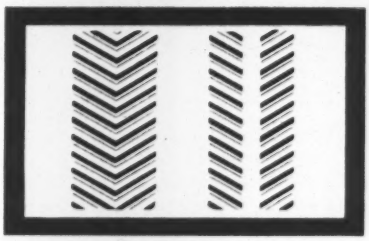
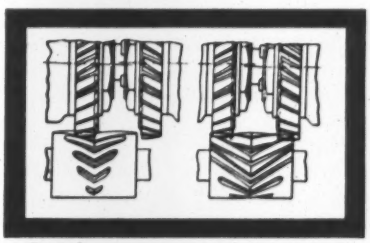
How to get and keep machine-tool precision:

design with accurate, long-lasting gears





Farrel herringbone gears have greater strength because they have greater tooth area as shown by this comparison. Left: Farrel continuous-tooth herringbone gear. Right: conventional double helical gear with center groove.



Farrel gears are precision-generated on a Farrel-Sykes machine. The two cutters reciprocate, each ending its stroke at the center of the blank. As they cut, they rotate to generate the helices and also slowly revolve in unison with the gear blank to generate the tooth contours precisely.

Include Farrel® continuous-tooth herringbone gears in your design — and you have a better machine tool to show for it. That's because these gears have the accuracy and durability so essential for precision machining.

The Farrel-Sykes method of gear generation assures extreme accuracy of tooth spacing, contour and helix angle. This pays off in smooth, uniform power flow.

What's more, the *backbone* in Farrel herringbone gears, formed by the meeting of the two helices without a center groove, puts the full face width of the gear to work. Result: Greater strength and stamina—your assurance of *sustained precision.*

Accuracy and *backbone*—these are the reasons so many top machine designers specify Farrel gears. Send for further information.

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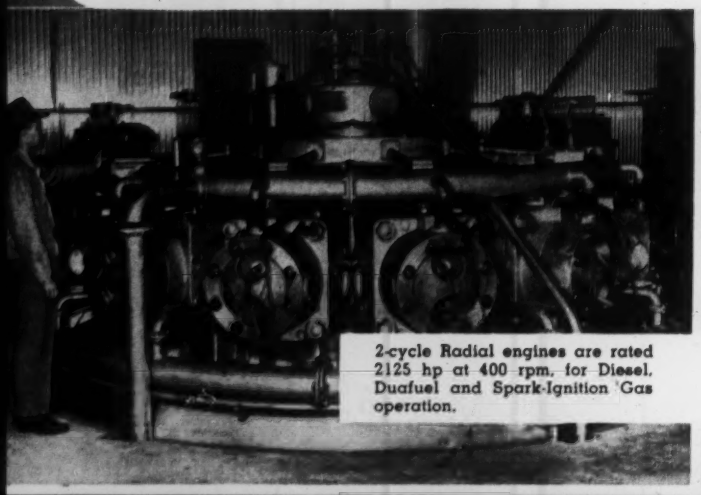
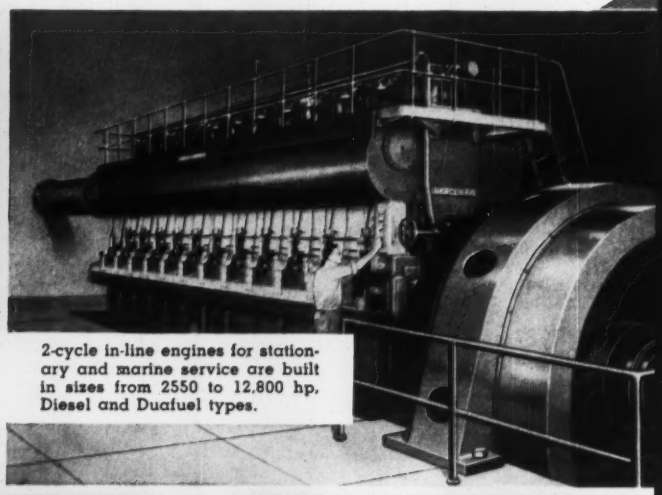
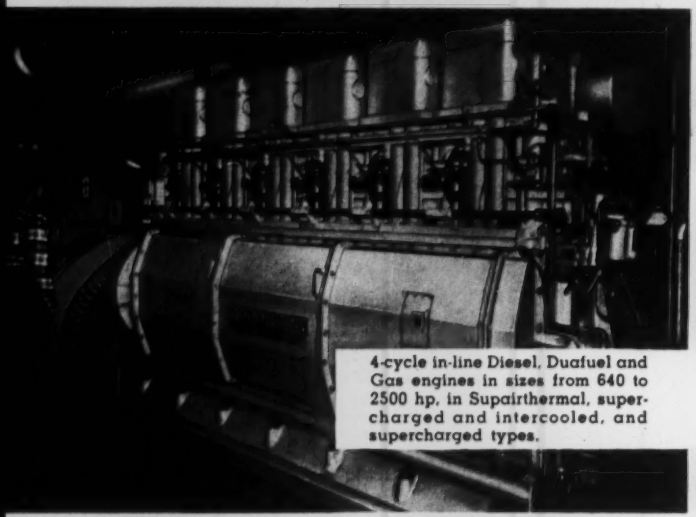


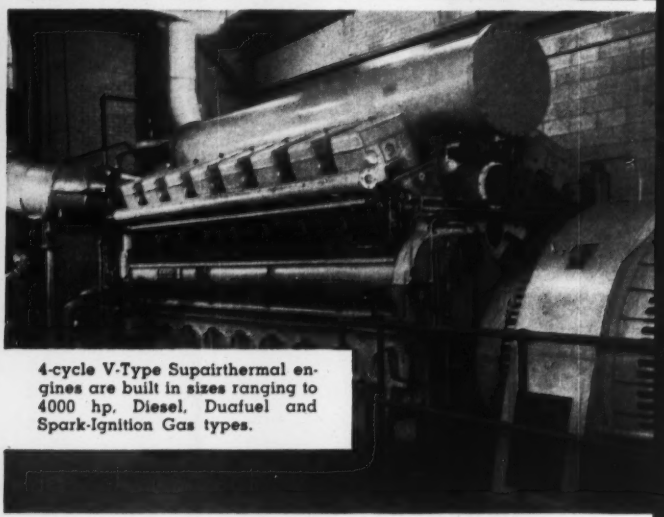
2-cycle Radial engines are rated 2125 hp at 400 rpm, for Diesel, Duafuel and Spark-Ignition Gas operation.



2-cycle in-line engines for stationary and marine service are built in sizes from 2550 to 12,800 hp, Diesel and Duafuel types.

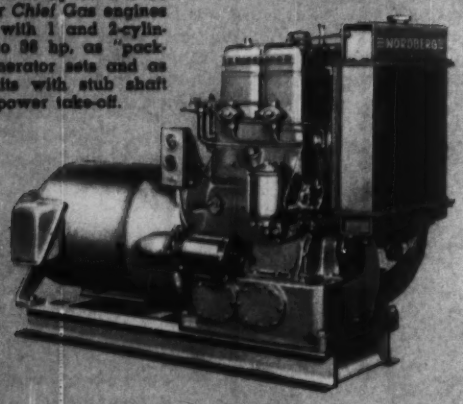


4-cycle in-line Diesel, Duafuel and Gas engines in sizes from 640 to 2500 hp, in Supairthermal, supercharged and intercooled, and supercharged types.



4-cycle V-Type Supairthermal engines are built in sizes ranging to 4000 hp. Diesel, Duafuel and Spark-Ignition Gas types.

Power Chief® Diesels are offered with 1, 2 and 3-cylinders, rated 10 to 45 hp or 8 to 30 kw. *Power Chief* Gas engines are built with 1 and 2-cylinders, up to 90 hp, as "packaged" generator sets and as power units with stub shaft or clutch power take-off.



● Pioneer in the Diesel and Gas engine industry, Nordberg has contributed many of the most notable advancements in the development of more efficient prime movers . . . all in the interest of improved fuel economy, simplicity of design, less maintenance and better overall performance. As a result of this experience, Nordberg today . . . with a full range of engine sizes, from 10 to over 12,000 hp, including Diesel, Duafuel® and Spark-Ignition Gas types, is in the best position to help solve your stationary and marine power problems.

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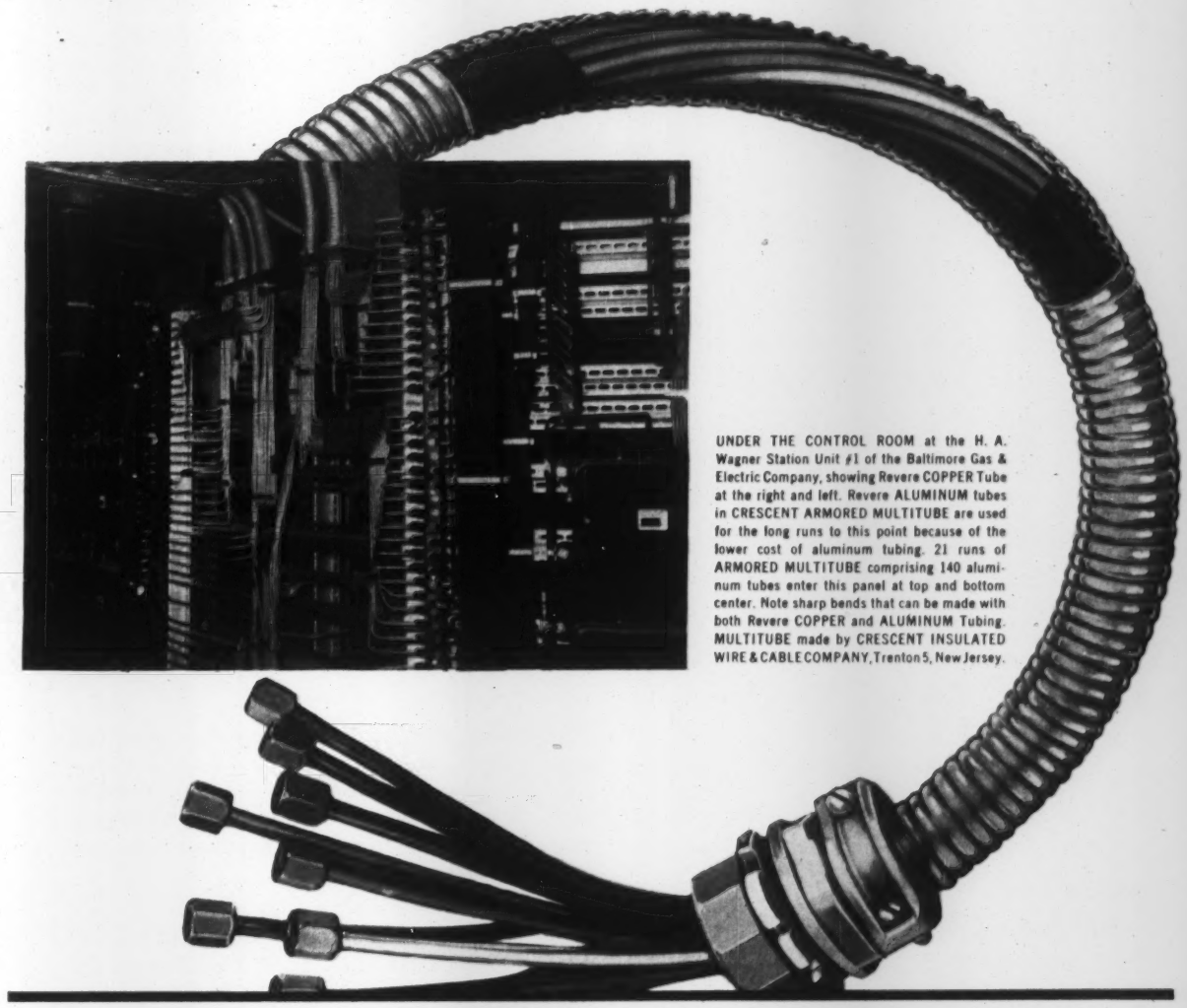

UNDER THE CONTROL ROOM at the H. A. Wagner Station Unit #1 of the Baltimore Gas & Electric Company, showing Revere COPPER Tube at the right and left. Revere ALUMINUM tubes in CRESCENT ARMORED MULTITUBE are used for the long runs to this point because of the lower cost of aluminum tubing. 21 runs of ARMORED MULTITUBE comprising 140 aluminum tubes enter this panel at top and bottom center. Note sharp bends that can be made with both Revere COPPER and ALUMINUM Tubing. MULTITUBE made by CRESCENT INSULATED WIRE & CABLE COMPANY, Trenton 5, New Jersey.

CRESCENT relies on REVERE

for dependable performance of its instrumentation and control tubing

REPORTS, "NOT ONE FAILURE."

The dependable performance of Revere Copper Tube in Crescent Armored Multitube*, ever since its inception, has led the CRESCENT INSULATED WIRE & CABLE COMPANY to fill its aluminum tube needs with Revere also.

In fact, Crescent, since it first started using Revere Copper Tube in 1953, reports not a single failure. And that's mighty important in instrumentation and control tubing service where utilities, chemical processing, petroleum, paper and similar industries can't afford the luxury of process failures.

Crescent Multitube, using either Revere Copper or Aluminum Tube, or both in combination, offers a completely protected installation for permanence, lower original installation cost, lower maintenance and a saving of time, space and money.

Crescent Armored Multitube consists of a group of Revere Copper or Aluminum Tubes, twisted together in cable form, protected by a flexible interlocked galvanized steel armor. Constructions are available employing plastic sheaths in combination with the armor for corrosive locations. Section of cabled tube pictured shows how Copper or Aluminum Tubes are encased inside the Armored Multitube. As many as 37 tubes of ¼" OD can be cabled in lengths up to 1,000 ft.

For details on Multitube write Crescent and for uniform quality copper and aluminum tube, speedily delivered, see the nearest Revere Sales Office.

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The Statue of Liberty was once in danger.

Not from a foreign foe. Not from a crackpot's bomb. This peril was less exciting . . . *but no less destructive.*

It was corrosion — corrosion that had been at work ever since Liberty first raised her torch.

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Something had to be done, that was clear. But what? Re-riveting wasn't practical. Too many hard-to-get-at spots in the statue.

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Do you have a metal problem? Then look into the Inco Nickel Alloys. Their properties and applications are described in a useful booklet, *Standard Alloys for Special Problems.* Write for a copy. After reading it, you may want some specific help. We're ready to give that, too . . .

All **INCO PLUS SERVICES** are yours for the asking: Corrosion Engineering • High Temperature Engineering • Fabrication Help • Casting Information • Field Information Centers • Convenient Sales and Service • Technical Publications. You are welcome to all the information and help we can give you whenever you are looking for answers to your metal problems.

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Volume 79 • Number 8

AUGUST 1957

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X-17 Research Rocket

Final preparations for X-17's journey into space are shown being made at Patrick Air Force Base, Fla. The 40-ft-tall rocket, powered by solid propellants, has proved extremely reliable over a large number of flights. It has flown successfully in 92 per cent of all launches and has performed perfect missions in more than 70 per cent. The lightweight (less than 6 tons) and relatively simple X-17 carries a 75-lb payload of instruments and radio to allow it to perform an extensive research role on each flight. The three-stage rocket was built by Lockheed's Missile Systems Division in Van Nuys, Calif.

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AUGUST 1957

George A. Stetson, *Editor Emeritus*
J. J. Jaklitsch, Jr., *Editor*

MECHANICAL ENGINEERING

Silent Lecturers

Arthur T. Vanderbilt and Piero Ferrerio

Two ASME lecturers, one a lawyer and judge, the other an Italian engineer, who recently addressed the Society on different subjects, have been silenced by death.

Chief Justice Arthur T. Vanderbilt of the Supreme Court of New Jersey, ASME's first Roy V. Wright lecturer, died on June 16 at the age of 68. Piero Ferrerio, chairman and president of the Italian Edison Company, the 1952 Calvin W. Rice Lecturer, suffered a fatal attack on June 26. Mr. Ferrerio was born in 1882.

Judge Vanderbilt was properly chosen to inaugurate the Wright Lecture for he was closely associated with Dr. Wright in interesting young people in politics as a career. Dr. Wright was an engineer—in fact, a past-president and Hon. Mem. of ASME—and was the originator and active leader, until his death, of the ASME Engineers Civic Responsibility Committee, now known as the Civic Affairs Committee. He wrote many papers on the engineer as a citizen and presented addresses on the subject all over the nation. Dr. Wright recognized the need for engineers to become interested and take an active part in politics, and he himself eventually was elected a senator in the legislature of the State of New Jersey. It was for this type of leadership that an ASME lectureship was established as a tribute to Dr. Wright.

Judge Vanderbilt was a leader in court reform, legal education, and good government. He was an outstanding defender of civil liberties and served in the front rank of the countrywide movement in the past half century to improve court structure, administration, and procedure in state and nation. Unification of court systems, modernization of court administration, and simplification of court rules were his main goals in public service.

Both men were closely associated in service to the same state; it was, therefore, appropriate that Judge Vanderbilt present the first Wright Lecture at the 1949 ASME Annual Meeting. His lecture, "Standards for Citizenship," was published in the November, 1950, issue of MECHANICAL ENGINEERING.

Mr. Ferrerio gave the Rice Lecture at the 1952 ASME Semi-Annual Meeting. Entitled "The Italian Power Industry," the lecture was printed in MECHANICAL ENGINEERING, September, 1952.

The Calvin W. Rice Lecture, founded in 1934, was named to honor the man who served as Secretary of ASME from 1906 to 1934, and to further his ideals to increase understanding among the engineers of various countries and to broaden the programs of Society meetings. Mr. Ferrerio's Rice Lecture fulfilled these aims admirably. In his lecture he gave a historical account of the Italian Power Industry which began in 1883 in the Milan plant, the first in Europe, built and operated by John W. Lieb, Jr., a prominent member of ASME. Some of the current problems that were facing the industry were also outlined by Mr. Ferrerio.

He was fully capable of this task for, as chairman and president of the Italian Edison Company since 1944, Mr. Ferrerio headed the most important public-utility operating and construction company in Italy. The Edison Group also includes firms exercising activities in other fields such as transport systems, steel mills with electric furnaces, machine works, electrochemical works, and the like.

Both lecturers are now silent, but their words and works live on.

new materials design should know

metallic materials + ceramics and refractory materials + plastics and rubbers + coatings

THE materials available to the design engineer are rapidly being increased and improved. Metallic materials are being pushed to new highs in temperature and tensile strength, and metals that were completely unused a few years ago are assuming importance.

A whole new area of optics has opened with the development of minute optical glass fibers. Ceramics are replacing metals for many high-temperature and special nuclear applications, particularly for fuel elements.

New plastics continue to be spawned at a rapid pace for almost every conceivable application, and synthetic rubbers are now better than the natural product. Coatings and finishes are affecting construction materials, with the metal-clad building rapidly replacing stone.

These are but a few of the developments in the field of materials.

metallic materials[1]

Among the metals in quantity use today but commercially unapplied a decade ago are titanium, zirconium, and molybdenum. High-strength heat-treatable titanium-alloy sheet is of such potential that it is being investigated in the Department of Defense Titanium Sheet-Rolling Program (1).[2] Rhenium, with the second highest melting point of all metals is superior to tungsten and platinum-ruthenium for electrical contacts, and of particular use in electron-tube construction.

Developments in ferrous-base metals have been extensive, especially in ultra-high-strength steels, precipitation-hardenable stainless steels, high-manganese stainless steels, iron-aluminum-molybdenum alloys, and hot-die steels for constructional uses.

New processes developed include vacuum melting and vacuum casting to minimize the hydrogen content of iron and steel. Chem-milling permits the etching out of excess metal where machining would be difficult. Cladding and honeycomb construction permit the combination of metals or alloys to take advantage of their combined properties.

[1] By Charles R. Simcoe, principal metallurgist, Battelle Memorial Institute, Columbus, Ohio.

[2] Numbers in parentheses refer to the Bibliography at the end of this section.

Based on four papers contributed by the Machine Design Division and presented at the Design Engineering Conference, New York, N. Y., May 20–23, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

that the engineer about

and finishes

Table 1 Properties of New Titanium Alloys

Alloys	Room-temperature properties in solution-treated condition: Ultimate tensile strength, psi	Tensile yield strength, psi	Elongation, per cent in 2 in.	Room-temperature properties in solution-treated and aged condition: Ultimate tensile strength, psi	Tensile yield strength, psi	Elongation, per cent in 2 in.
Ti-3Al-6Mo	135,000	—	15	180,000	160,000	7
Ti-4.5Al-3Mo-1V	150,000	125,000	15	170,000	150,000	10
Ti-2.5Al-16V	100,000	—	15	180,000	160,000	6

Table 2 Composition of Ultra-High-Strength Steels

Steel type	Average composition, per cent: C	Mn	Si	Ni	Cr	Mo	V	Tempering temperature, F	Ultimate tensile strength, psi
SAE 4340	0.40	0.75	*	1.83	0.80	0.25	—	450	270,000
Hy-Tuf	0.25	1.35	1.50	1.83	0.30	0.40	—	550	230,000
Super Hy-Tuf	0.40	1.30	2.30	—	1.40	0.35	0.20	550	290,000
Hi-Carbon Super Hy-Tuf	0.47	1.28	2.42	—	1.11	0.42	0.25	500	325,000
Tricent	0.43	0.80	1.60	1.83	0.85	0.38	0.08	500	300,000
Super Tricent	0.55	0.80	2.10	3.60	0.90	0.50	—	400	340,000

* Normal silicon 0.20–0.35 per cent.

Table 3 Mechanical Properties of Ultra-High-Strength Steels

Steel type	Tempering temperature, F	Ultimate tensile strength, psi	Yield strength (0.2 per cent), psi	Elongation, per cent in 2 in.	Reduction of area, per cent	Charpy V-notch impact, ft-lb
SAE 4340	920	190,000	180,000	15	49	27
SAE 4340	450	270,000	212,000	10	35	19
Hy-Tuf	550	230,000	190,000	13	49	30
Super Hy-Tuf	550	290,000	241,000	10	35	14
Hi-Carbon Super Hy-Tuf	500	325,000	—	—	24	10
Tricent	500	300,000	242,000	8	23	18
Super Tricent	400	340,000	—	—	—	12

New Forms With Metals

Honeycomb sandwich. Of the several ways of combining metals, the honeycomb sandwich is particularly attractive to the airframe industry (2). In honeycomb-sandwich construction the cover plate can be made of aluminum, stainless steel, titanium, or other solid metals where strength or heat resistance is needed. These can be bonded to cores made of paper, reinforced plastics, aluminum, steel, or titanium by adhesives, soldering, brazing, or spot welding. A considerable amount of aluminum honeycomb structure has been used in the aircraft industry, but the present trend is toward stainless steel and titanium.

In addition to construction applications for exterior and interior curtain walls of buildings, honeycomb-sandwich structures could be used in appliances, cabinets, furniture, and rolling stock. Aluminum cover plates bonded to an aluminum core by adhesive bonding should be especially attractive.

Cladding. Another important method of combining metals is by cladding. Two or more materials can be bonded together, usually by rolling. While the method is not new, it is being used more extensively in such applications as atomic fuel element construction, and other use could be made to combine the desirable features of more than one metal or alloy. For nuclear fuel use, zirconium, aluminum, or other metals are bonded to a core of fissionable material to provide corrosion and erosion resistance. Such factors as hot and cold-rolling, compatibility between the core and clad materials, diffusion and phase relationships at the bond interfaces, and methods of testing the strength of bonds, have been studied extensively.

New Methods

Chem-milling. A relatively new method of forming metals where unwanted material is etched out, rather than machined away, is Chem-milling (3). It is being used in the aircraft industry, and can be applied to large structures and complex forms where machining would be impractical or impossible. Sheet structures containing integral ribs and stiffeners can be made from plate. Very close tolerance control is possible, especially with aluminum.

Vacuum casting. Vacuum casting has been applied to eliminate gases and volatile materials from metals and, particularly, to minimize the amount of hydrogen in iron and steel, which has been shown to be the cause of failure of large steel forgings, such as turbine rotors, and other steel parts which have been heat-treated to high strengths.

Many other metals and alloys are presently melted and cast, or cast only, in vacuum. Improvements have been noted in high-temperature properties, impact transition temperatures, and the ductility of materials processed in this manner.

Zone refining. A new process for purifying metals was developed at the Bell Telephone Laboratories as a result of a need for extremely pure material in transistors. The process is limited to small quantities of material at

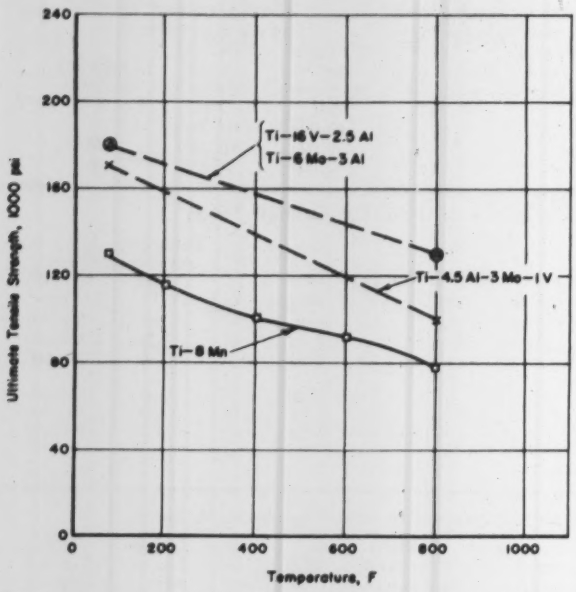

Fig. 1 Improved ultimate tensile strength of new titanium alloys

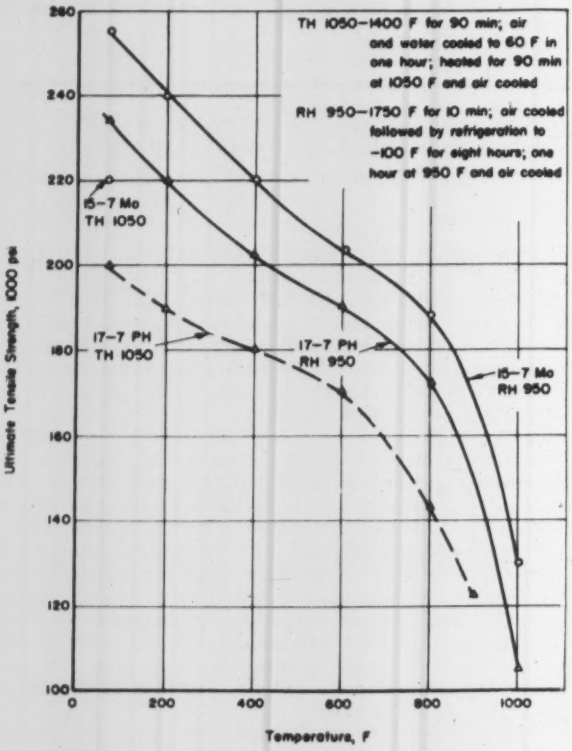

Fig. 2 Ultimate tensile strength of new precipitation-hardenable steels

present, but is being developed for larger quantities. The method is called zone melting, and is an adaptation of fractional crystallization, long used for the purification of other materials. It is accomplished by moving a molten zone of metal along the length of a bar. Since impurities have a greater solubility in the liquid phase than in the solid phase, they tend to concentrate in this molten zone and are carried to one end of the bar. Eventually, when the process is repeated over and over, nearly all the impurities are swept out of the bulk of the bar. Almost inconceivable purities of 99.999999 per cent are common.

Roll forming. Metal fabrication by rolling metal powder directly into finished strip (4) was tried during World War II by the Germans. At least one company in this country is reclaiming copper scrap in powder form by rolling it into strip, and the process appears to be especially attractive for the fabrication of nuclear fuel elements. If the part is compacted cold, and never heat-treated, the very fine grains produce unique properties, and no preferred orientation is noted within the sheets. A metal strip can be clad on one or both sides by using it as the carrier of a chosen powder. A larger percentage of any scrap material reclaimed in powder form can be made into strip, rod, and wire, more cheaply than by conventional techniques.

New Metals and Alloys

Titanium. Measurable quantities of titanium, principally used in the manufacture of airframes and jet engines, have been produced within the last two or three years. Most promising alloy in the development stage is Ti-6Al-4V which may be the first truly all-purpose titanium alloy. Weldable in many applications, and superior for forging, it also shows promise as a fastener, and can be rolled into sheet with superior inherent strength and the added advantage of moderate heat-treatment response.

High-strength heat-treatable titanium alloy sheet is also under development. Among the compositions being studied are Ti-4.5Al-3Mo-1V, Ti-16V-2.5Al, and Ti-6Mo-3Al. These alloys have greater strength-weight ratios than ferrous-base alloys up to 400 F, and, in the case of Ti-16V-2.5Al, up to 700 F. If these alloys can be developed into useful aircraft constructional materials, their properties definitely ought to insure the future of titanium for some time to come.

The next group of titanium alloys to be worked on should push ultimate tensile strengths above 200,000 psi at room temperature.

Beryllium. Beryllium, with a density $^1/_4$ that of steel and $^1/_2$ that of aluminum, has considerable structural potential for aircraft (5). It has a reported ultimate tensile strength of from 65,000 to 125,000 psi and a modulus of 44 million at room temperature. On a strength-weight basis, it may be superior to all present metals up to 1100 F. Unfortunately, the remarkable properties of this metal cannot be realized at present because it is extremely brittle at room temperature, and present costs are $100 per lb for powder. Toxicity, especially in powder form, is another disadvantage.

Chromium. New metals in the high-temperature group include chromium, columbium, and molybdenum. The greatest difficulty in using chromium is its lack of ductility, but swaged iodide chromium was made recently which shows excellent tensile ductility at room tempera-

ture (6). The ductility is lost completely, however, if it has been recrystallized. On the other hand, chromium-base alloys with as much as 50 per cent iron or nickel show excellent tensile ductility after recrystallization. For example, a 50 per cent chromium and 50 per cent nickel alloy has an ultimate tensile strength of 154,000 psi, a yield strength of 123,000 psi, elongation of 25 per cent in $^3/_4$ in., and 57 per cent reduction in area. Elastic modulus is 32 million at room temperature and 22 million at 800 C.

Further advances in research should lead to the commercial application of chromium-base alloys, once ductility and other problems have been resolved.

Columbium. Columbium and columbium-base alloys show remarkable short-time stress-rupture properties at temperatures as high as 2200 F (7). Short-time tensile strengths at 2200 F are 15,000 to 16,000 psi with 11 to 30 per cent elongation in 2 in.

Columbium, like most other high-melting-point metals, requires protection from oxidation, and tests were performed either in vacuum or inert atmosphere.

Molybdenum. Molybdenum, which has the greatest inherent strength to the highest temperatures, possesses two very important disadvantages—lack of room-temperature ductility, and volatile oxidation at high temperatures (8). Research over the past 5 or 6 years has shown that the lack of room-temperature ductility is probably associated with a grain-boundary oxide. Research has shown that alloying will not sufficiently improve oxidation resistance; coatings must be developed for this purpose.

Recent developments indicate that the addition of 0.5 per cent titanium to molybdenum imparts a considerable increase in strength properties (9). The 0.5 per cent titanium alloy has a short-time elevated-temperature strength at 1600 F which is equivalent to unalloyed molybdenum at room temperature. The stress to rupture in 100 hr was increased by this alloy addition from 31,000 psi to 66,000 psi at 1600 F, from 22,000 to 53,000 psi at 1800 F, and from 13,000 to 43,000 psi at 2000 F.

Rhenium. One of the most important potential uses of rhenium is for construction material in electron tubes where residual water vapor reacts with tungsten to form tungsten oxide, and sets up a "water cycle" of oxidation and deposition. Rhenium resists water cycling, does not form carbide, and remains ductile after thermal cycling, being undamaged by fatigue or impact. In addition to the second highest melting point of all metals 5740 F, it has a Young's modulus of 67 million and an ultimate tensile strength of 170,000 psi.

Rhenium is a major alloying element in molybdenum which has practically no ductility at room temperature. It can be easily cold rolled 95 per cent with the addition of 35 per cent rhenium. Rhenium alloyed with tungsten can be worked at 800 to 1000 C, and this latter material may also be of interest in electron tubes.

Development of Old Metals

Great strides have been made in the development of more common metals. Ultra-high-strength steels and precipitation-hardenable stainless steels are being developed as well as high-manganese stainless steels to replace high-nickel grades. Hot-die steels for constructional uses, especially in aircraft, and iron-aluminum-molybdenum alloys known as Thermenol are other developments.

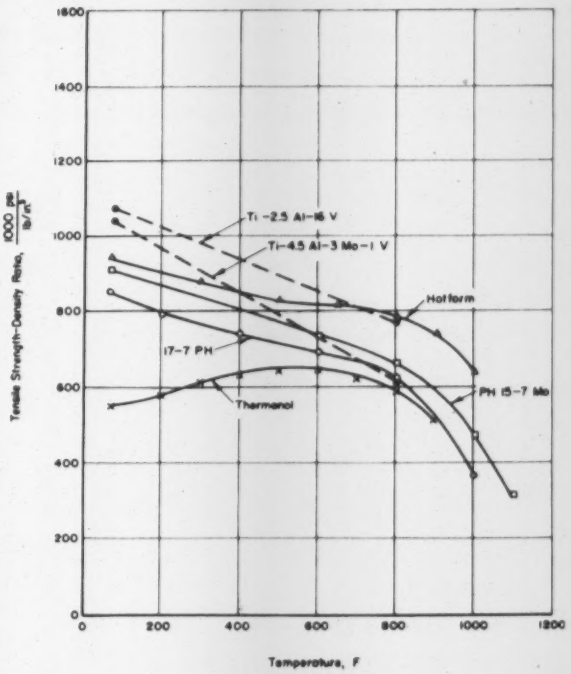

Fig. 3 A comparison of strength-density ratio as a function of temperature for various constructional materials

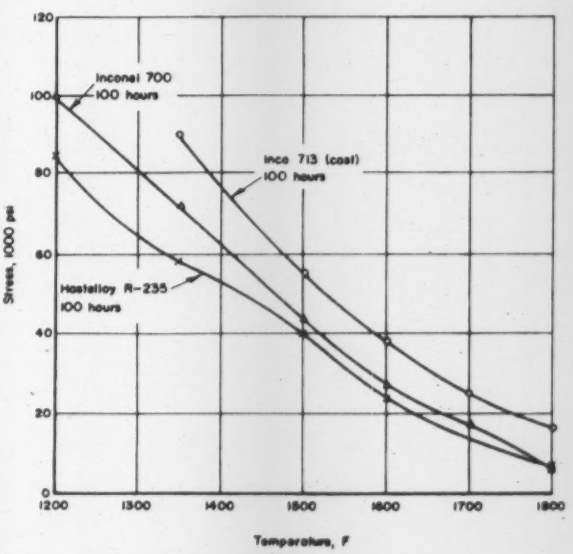

Fig. 4 100-hr rupture stress for new nickel-base alloys. Inconel 700 is a Ni-Co-Cr Alloy. Hastelloy R-235, although only air-cooled, is termed precipitation-hardenable. Inco 713 is the most recent development.

Table 4 Nominal Composition of New Nickel-Base Alloys

Alloy designation	Percentage										
	Ni	Cr	Fe	Co	Mo	Ti	Al	Cb	Mn	Si	C
Inconel 700	46.0	15.0	0.8	29.0	3.0	2.2	3.2	—	0.08	0.25	0.13
Inco 713	Bal.	13.0	1.0	—	4.5	0.6	6.0	2.25	0.15	0.4	0.12
Incoloy 901	40.0	13.0	Bal.	—	6.0	2.5	0.20	—	0.5	0.35	0.05
Hastelloy R-235	Bal.	15.5	10.0	2.5	5.5	2.5	2.0	—	—	—	0.16

Ultra-high-strength steels. Strength has been increased in this group by increasing the resistance to tempering at any given tempering temperature, by addition of large amounts of silicon or variations in other alloying elements, such as carbons, manganese, nickel, chrome, molybdenum, and vanadium. The composition and properties of this group are shown in the tables.

Precipitation-hardenable stainless steels. Increased ultimate tensile and yield strengths have been achieved with heat-treatment of 17-7PH, designated Condition RH-950, which consists of heating at 1750 for 10 min and air cooling.

The material is refrigerated at −100 F for 8 hr and then tempered at 950 F for 1 hr. This treatment produces ultimate tensile strengths of approximately 230,000 psi and yield strengths of 215,0000 psi with 7 per cent elongation. This is an increase of approximately 38,000 psi in both the ultimate and yield strengths over the TH-1050 treatment.

A new precipitation-hardening alloy has been announced by Armco which is known as PH15-7Mo (10). This alloy contains from 14 to 16 per cent chromium, 6.5 to 7.75 per cent nickel, 2.0 to 3.0 per cent molybdenum, and 0.75 to 1.50 per cent aluminum. It has exhibited ultimate tensile strengths of 220,000 and 240,000 psi, after the TH-1050 and RH-950 heat-treatments, respectively.

A bar, forging, billet, and plate alloy with slightly better tensile properties at both room temperature and elevated temperatures has been developed which is a companion to the AM-350 alloy, and is known as AM-355. The only apparent compositional change is a decrease in chromium from 17 to 15 per cent.

Thermenol. The Thermenol series of alloys contains from 10 to 18 per cent aluminum and from 2 to 4 per cent molybdenum (11). Some advantages of Thermenol are its low density (0.24 lb per cu in.), its ability to retain room-temperature strength properties to temperatures as high as 1000 F, its excellent high-temperature oxidation resistance and corrosion resistance. Some of its disadvantages are low ductility at temperatures below 900 F, low heat conductivity, and very high work-hardening rate, which make forming, machining, and grinding operations somewhat difficult.

Nickel-base alloys. The compositions of recently announced high-temperature nickel-base alloys are shown in Table 4 (12, 13).

The stress to rupture properties are good. Inconel 700, the Ni-Co-Cr alloy, retains strength properties at 1650 F, which are comparable to Inconel X at 1500 F. The new nickel alloy known as Hastelloy R-235 is termed a precipitation-hardenable alloy although only air cooling from 2150 F is required. Because the precipitating particles agglomerate slowly, there is little decrease in strength during long exposure at high temperatures. The most recent development is Inco 713, which increases the operating-temperature range of nickel-base materials up to 200 F over the previous alloys.

Incoloy 901 is a nickel-iron-chromium alloy with low strategic content for use in aircraft and industrial gas-turbine components requiring high creep and rupture strength at 1000 to 1400 F.

Cobalt-base alloys. Cobalt, the first high-temperature metal for turbosuperchargers, is now in much greater supply. New alloys have been developed, such as AMS 5537 (L605, and Stellite 25) as sheet and for honeycomb structures, and a new alloy, WI-52, containing more tungsten and columbium than Stellite ×40. Cobalt imparts good thermal shock resistance to other high-temperature metals, and is especially useful in die materials.

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* ceramics and refractory materials[3]

There have been numerous recent developments in all of the fields of ceramics—glass, coatings, refractories, cermets, electronic ceramics, and mechanical ceramics.

Glass

New developments in glass (1)[4] include new processes and treatments, new types, and new uses for glass. Process and treatment developments include: Centrifugal casting of bulbs; sintering after dry pressing, slip casting, or chemical treatment (foam glass, chemical forming, for example, photosensitive and devitrified glass); electrically conducting coatings and fused seals; reflection coatings, and electroluminescent glass. Currently, glass containers are being produced of lighter weight of uniform wall thickness and at higher speeds than ever before. Within limits this trend is expected to continue.

Optical glass. Quantities and kinds of optical glass, mass-produced to extreme quality and homogeneity, have increased significantly. Selected lots are now spun into fibers, in the 25-micron thickness range, to serve as light pipes in bundles constituting the new field of fiber optics. Fiber optics will apply as image conveyances to medicine where crooked paths are necessary, as in gastroscopy, to coding, to image flattening, and similar applications. Optical glass fibers of 1 mm are being tested as dosimeters placed in real or phantom tissue in cancer research. Optical glass plates are being investigated as dosimeters in food and drug sterilization research. In either case a stable and strong absorption change, induced by high energy radiation, represents the mechanism. New optical glasses for both lenses and windows have been developed for the infrared region (calcium aluminate, barium titanate, and high lead glasses).

Progress has also been noted in lighting glass, filters, and signalware, for example, ultraviolet and infrared-transmitting glass, incandescent lamp envelopes, diffusing and light-directing glassware, electroluminescent and explosion-proof light globes.

Improved acid-alkali resistant glass operates at higher temperatures and pressures, and has increased thermal shock resistance.

Surface treatments. Silicones and other ultra-thin surface treatments, waxlike or organic in nature, have been applied to glass to greatly reduce scratching of containers during handling and processing. Silicone sprays have been recommended. The protective uses of ceramic coatings on glass containers to secure required protection against light—to prevent photochemical deterioration of pharmaceuticals, medicinals, and many other products—is of interest (2). The proper thickness is applied to the outside surface of the container and permanently fused to the base container. These are essentially lead borosilicate glasses to which metallic oxides are added to develop particular colors. These durable ceramic coatings also provide for the control of the light-transmission characteristics.

Glass dispersion. A new glass dispersion provides a protective and lubricating coating during the forging of special alloy steels, titanium, and other metals. Applied to metals at room temperature, the glass fuses to the surface during the heating cycle and inhibits oxidation and surface contamination. A boron nitride dispersion has been found to be a good mold-release agent for metal molds and for automatic-glass-molding-machinery release.

Glass fibers. There has been increased production of glass fibers for many extended uses, such as household appliance insulation, noise control products, roofing products, pipe insulation, and insulation for air conditioners, including replacement air filters (1). Fiber-glass laminates of very high strength-to-weight ratio have increasing application for structural purposes, for example, glass-polyester parts being made for military applications (ducts and armor); automotive applications of glass-fiber products for instrument panel pads, sun visors, sound absorbing, and temperature-control insulation; and in electrical insulation primarily as replacement for phenolics.

A new fiber glass has been reported which, after being exposed for days at 2350 F, does not soften. This was developed for refractory applications. A micro-quartz lightweight insulation is being marketed which can be used at 2000 F and higher. It weighs but 3 lb per cu ft.

Glass fibers have been suggested as a paper additive to improve dimensional stability (3). It would appear that the addition of relatively small amounts of glass fiber to pulp can result in improved dimensional stability in the sheet, without detracting from other physical properties, and also can result in faster drying and reduced machine-width shrinkage.

A glass paper as a surface coating for plastics is being applied to increase surface abrasion resistance.

Coatings

The trend in porcelain enamels, as noted in recent technical meetings, is toward lower temperature coatings (1000 to 1350 F) applied on lighter gage metals, and the use of thinner films. This reduces problems of distortion and warping of the metal. The new low-temperature enamels for steel and aluminum are made possible through the use of lead frits. Both steel and stainless foil 0.001 in. thick are now being enameled for high temperature service.

A new ceramic paint, now being used by the Army in mufflers and other high temperature applications up to 1400 F, contains a frit and a silicone.

In the field of higher temperature coatings, high temperature creep in alloys, for example, 80 per cent Ni, 20 per cent Cr, has been reduced under some conditions as much as 50 per cent at temperatures as high as 1975 F and loads up to 1200 psi. At 1800 F and 2200 F the creep decreased for a period of 20 to 30 hr after which it increased; this might have resulted from devitrification of the coating.

[3] By John H. Koenig, director, and Edward J. Smoke, professor, School of Ceramics, Rutgers, The State University, New Brunswick, N. J.

[4] Numbers in parentheses refer to the Bibliography at the end of this section.

Molybdenum disilicide provides satisfactory oxidation resistance up to 3600 F as a coating on molybdenum.

Considerable progress has been made in flame-spraying ceramic coatings on different metals, for example, coatings of alumina, zircon, zirconia, and tungsten carbide, in thickness from 0.002 to 0.050 in. and finished to 0.5 micro-in. rms. Progress has been made in lowering porosity of such coatings to as low as 1 per cent. Illustrative uses include: protective coatings in jet, ramjet, and rocket engines; bearing surfaces; feed rolls; bus-bar insulation; circuit-breaker components; protection for valve plugs, pump shafts, and gas-turbine parts.

Refractories

Magnesite chrome basic refractory as a melt-cast product is being used in the steel industry to lower furnace-maintenance costs. Fire-brick applications and high-temperature castable refractories for electric arc furnace roofs are also new.

Refractory castables are also being used for jet aircraft and for missile-launching platforms; and silicon-carbide type refractories are playing vital roles in high temperature work.

A novel refractory development is a ceramic rope which resists heat up to 2300 F and is woven from a synthetic aluminosilicate fibrous material. This rope is extremely light in weight with a length of 30 ft at 0.5-in. diam weighing but one pound; this is 50 per cent lighter than an asbestos equivalent. It is used for expansion joints and high-temperature caulking.

Cermets

Cermets are made by cold forming and sintering or hot pressing. The present well-known cermets include: metal-bonded zirconium boride, chromium boride, nickel aluminide, and titanium carbide. In general, the borides are not as strong at room temperature as titanium carbide; however, at elevated temperatures they are much stronger.

In this field, a new cermet produced from silicon carbide and molybdenum provides for tremendous increase in strength with temperature (4). At room temperature the transverse strength is 42,200 psi and increases to 71,900 psi at 1800 F. This latter value is among the highest attained in this temperature range.

For jet-engine applications a cermet based on chromium-molybdenum boride, and used up to 1800 F, exhibits better oxidation resistance and hot strength than titanium carbide, and has equivalent thermal shock resistance.

Tungsten and titanium carbides resist handling of sodium and sodium-potassium and other metals at 1050 F and above in pumps at 120 psi head over 2000 hours without wear (5).

Another unusual property of a cermet, made from high purity tantalum carbide, results in the most uniform, concentrated light source yet developed. This material as the target is heated to a higher temperature than tungsten could withstand. The potential use for this new R-F lamp is in medical research, radar, air traffic control, printing, and projecting of motion pictures.

Unusual Constructions

The extremely high compressive strength of ceramics has led to its consideration in a number of constructions where its other unique properties, such as refractoriness, and hardness are also of practical interest. Prestressed ceramics are being studied for aircraft structures (6).

Several types of ceramic honeycomb sandwich constructions, which can withstand temperatures up to 3000 F in repeated heatings, have been developed. These have compressive strengths up to 30,000 psi. The lower temperature variety is made of asbestos. The higher temperature type is made of long-fiber asbestos paper formed as hexagonal or square cores, dipped in alumina. These form the honeycomb on either surface of which a skin, made similarly, is applied. The whole is assembled and fired to 3000 F, burning out the paper and leaving the honeycomb alumina structure (total thickness 0.020 in.). The fired structure can be machined. Another sandwich construction reportedly used in a new high-speed jet plane involves the use of fiber glass as a honeycomb material between two layers of metal. This results in high resistance to buckling under temperatures and pressures encountered. A ceramic foam has also been developed which can be used continuously at 1600 F. This can be tamped or packed into relatively complex cavities. Some proposed uses include thermal and electrical insulation, core materials, fillers, and potting of electronic components.

Stability

The unique and stable properties of ceramics, particularly with respect to hardness and refractoriness, have provided many unique applications. Complete roller bearings, approximately $2^1/_2$ in. in diam and 3 in. in length, including rollers and racers, have been made from high alumina ceramics. The integral parts must be machined to 0.0001 in. The coefficient of friction of alumina on alumina is low, and it is claimed that no lubricant is necessary.

Alumina ceramics with a hardness greater than tungsten carbide are used in making pumps for handling abrasive and corrosive materials. The plungers for these pumps have been made from $^1/_8$ to 4 in. in diam and in lengths from 7 to 48 in.

Another potential application is for radomes, the dielectric windows, which house the radar equipment in the nose of a fast-flying plane or missile. Other types of materials are being considered for this purpose including devitrified glass, glass-bonded mica, and other polycrystalline ceramics. These and other type technical ceramics are now supplied as pistons and cylinders with maximum clearance of 0.0015 in.; parallel faces within 0.0005 in.; flatness within light bands; thickness 0.007 in. and up; tubes as small as 0.015 in. OD and 0.008 in. ID; threaded screws as small as 2–56; and drilled holes as small as 0.010 in.

A new high-temperature guard to protect metals from moisture and fumes utilizes ceramic-to-metal seals.

Hardness

The inflexibility, extreme abrasive resistance, and high strength of some ceramic materials allow their use as tools for high-speed machining of materials, especially metals, to close dimensional tolerance. The high rigidity prevents chattering and results in smoother cuts. Being nonmetallic, the ceramics do not weld to the metal being cut, and withstand more readily the high temperatures developed at the cutting edge without

losing their properties; in fact, this extreme refractoriness obviates the need for coolants. These ceramics are non-absorbent, acid-resistant, and not subject to oxidation. Actual case histories of machining costs show reductions from 50 to 80 per cent through use of ceramic tools. Boron nitride, a new synthetic material, will scratch diamond and withstand temperatures greater than 3500 F, while diamond burns at approximately 1600 F.

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*plastics and rubbers[5]

An example of the design and application possibilities of plastics is the modern automobile which contains 15 to 20 lb. There are about ten different plastic materials or copolymers used in the car's electrical system, fuel system, in the transmission, and in the body; in the running gear and engine, and in the numerous accessories.

Vinyls. A new development in vinyls is the spread coating of plastisols on steel. The flexibility permits fabrication of the steel without cracking the coating. It is possible to stamp out auto fenders from this coated steel. The coated-steel price is estimated to be on the order of half that of laminated vinyl.

Vinyls are being applied to the plastic-pipe field and an estimated 6 million lb of resin are being consumed in this type of application.

Polystyrene. Polystyrene, the second largest in sales of plastic materials, sold close to 600 million lb last year, 400 million being in molding material. The largest single application is for refrigerator cabinet parts. These are made from standard styrene having impact strengths of 0.25 to 0.6 ft-lb or impact-grade styrene having impact strengths of from 1.5 to 11 ft-lb. Styrene acrylonitrile copolymers, the higher impact materials, will find even more extensive use in this field.

Polyethylene. Polyethylene, a thermoplastic made by the polymerization of ethylene, is the fastest growing plastic at the present time and was third in sales last year with 500 million lb.

It is partly crystalline and partly amorphous with varying properties as the crystallinity is changed. Manufacturing pressures and temperatures affect the crystallinity, and generally speaking, a high-pressure and high-temperature process is used to produce polymers of low to medium crystallinity while the low-pres-

[5] By Wyman Goss, manager, phenolics manufacturing, Chemical Materials Department, General Electric Company, Pittsfield, Mass.

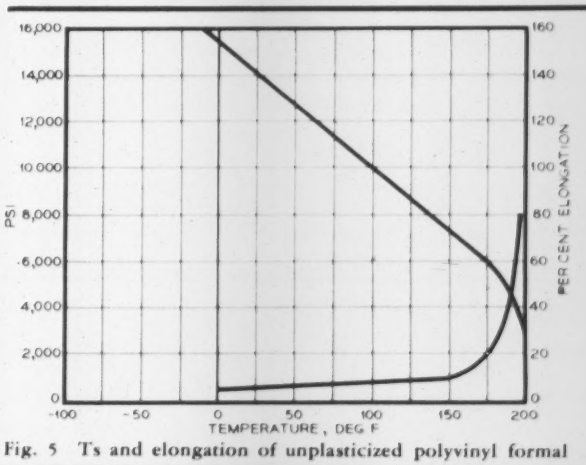

Fig. 5 Ts and elongation of unplasticized polyvinyl formal

Table 5 Selected Properties of Polyethylene

Density range	Low	Medium	High
Density, grams per mililiter	0.912 to 0.925	0.926 to 0.941	0.942 to 0.965
Heat resistance, max operating temp, F	140 to 175	160 to 200	250
Heat distortion 66 psi, F	40 to 50 C	50 to 65 C	60 to 82 C
Izod impact, ft-lb	16	16	0.5 to 5.5
Tensile, psi	1500 to 2400	1600 to 2500	2500 to 5000
Modulus, psi	14,000 to 38,000	35,000 to 90,000	85,000 to 160,000

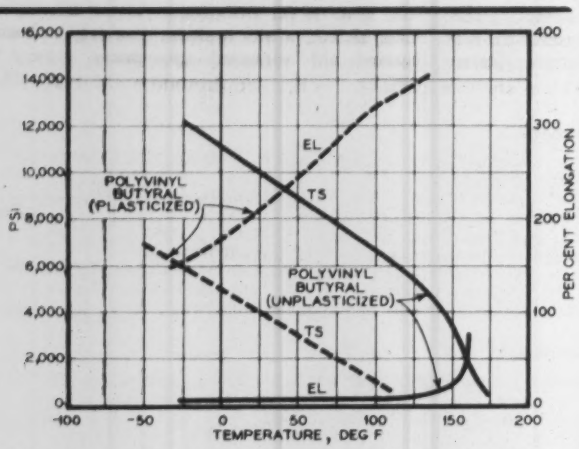

Fig. 6 Tensile strength, elongation of polyvinyl butyral

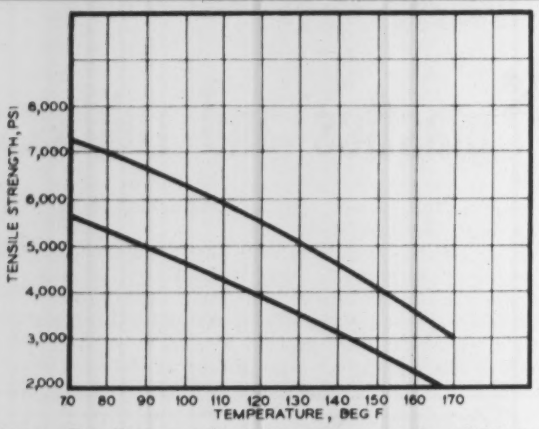

Fig. 7 Tensile strength versus temperature for rigid vinyl

Table 6 General Properties of Irradiated Polyethylene

Specific gravity	0.92
Thermal conductivity, cal/sec/cm²/C/cm	8.0×10^{-4}
Water absorption, per cent	<0.1
Melting point	None, behaves like an ideal rubber above 110 C
Coefficient of linear expansion, in/in/C	2×10^{-4}

Table 7 Chemical Resistance

Environmental stress cracking	No failures after a year in glacial acetic acid or Igepal solution at room temperature, or after 2000 hr at 75 C
Chemical resistance	Excellent resistance to alkalies, to acids except nitric, and to most other common water-soluble chemicals
Solvent resistance	Good resistance to most organic solvents below 60 C. Above 60 C, is swollen by hydrocarbons, halogenated hydrocarbons, and aromatic solvents
Outdoor weathering	Should be protected from sun
Shelf life	Excellent
Thermal stability	Must be protected from oxidation

sure process is used to produce highly crystalline linear polymers. The crystalline phase is of higher density than the amorphous phase; therefore "medium" and "high," referring to density, are often used to describe the degree of crystallinity.

The new high-density product has gradually become available and some German-made product is being sold in this country.

This high-density material possesses higher tensile strength, higher heat resistance, the modulus increases, and impact decreases.

To further complicate the polyethylene picture is the announcement of polypropylene, a material of similar characteristics but with even greater stiffness and higher heat resistance.

Higher density polyethylene from the conventional high-pressure process has also been developed. This product, having a density of 0.93 to 0.94, will also have improved heat resistance, stiffness, clarity, and strength. These higher density products will make it possible to fabricate articles that require sterilization, and semi-flexibility.

High-density polyethylene has extremely interesting possibilities as wire coating, where the high-density material has better heat resistance and better abrasion resistance and much better oil resistance. This product is being evaluated in seat-cover applications, and rope made from fibers is already on the market. Once again it is believed that the high-density polyethylene will compete with rigid vinyl pipe in such fields as food processing, where steam sterilization is used. Films from the higher density polyethylene are outstanding for clarity, strength, and heat resistance, making them very desirable for application to the packaging industry. Many of the problems which have been bothering the high-density-polyethylene industry will be solved in 1957, and this is a product which will bear watching.

Considerable work is being done with polyethylene vacuum-forming sheet and when the present difficulties are ironed out, large new fields of polyethylene containers will be possible.

Nuclear Vulcanization

When polyethylene, which has already been fabricated, for example, film, or pipe, is exposed to a beam of high-energy electrons, cross linking or vulcanization occurs. A thermoplastic material which melts on heating thus becomes a thermoset material which will only soften upon heating but will not melt.

In addition to the form stability contributed by irradiation, better chemical resistance and slightly better physical properties result. By incorporating stabilizers to permit prolonged use at elevated temperatures, irradiated polyethylene tapes and films have found application as insulation in many types of electrical equipment. Larger amounts of fillers, such as carbon black, can also be incorporated in polyethylene if the fabricated parts made from this composition are subsequently cross linked. This has permitted the development of semiconducting cross-linked polyethylene tapes and films which augment the line of irradiated polyethylene insulating tapes.

In addition to all of the above properties, irradiated polyethylene containing the proper stabilizers will possess the following unique properties: Excellent resistanec to thermal overloads, nonmelting character, elimina-

tion of the tendency to stress crack, stable electrical properties over a wide-temperature range, high resistance to surface arcing or tracking, ability to form tight, waterproof, and dustproof sheaths on taped objects.

Phenolics. Phenolics, the fourth largest plastic item in volume sales and largest of the thermosetting resins, sold about 450 million lb of products, 200 million as molding materials, and 75 million of resins for laminating. Other uses are for plywood binder, adhesives, resin binders for abrasives, break bands, insulating wool, and surface coatings.

During the past year all suppliers of phenolic materials have continued their development of faster curing, easier molding material, and the technological competition between suppliers is tremendous. The use of rubber-modified phenolic molding materials continues to grow in applications where real abuse resistance is a necessity.

Heat resistance has been improved by 50 F, and it is now possible to find an improved arc resistance or tracking resistance in low-cost phenolic materials. The product is capable of being molded by transfer and compression techniques, and its properties will allow for shorter tracking paths, thus resulting in smaller, more compact parts because less distance need be provided between electrical contacts. At the same time, low cost good dimensional stability, appearance, and strength are retained. The product, being partially mineral filled, has good heat distortion, well over 300 F. This suggests the possible use in applications where high operating temperature precludes the use of many other molded plastics.

Glass-filled phenolics are one of the higher priced specialty items which have excellent mechanical characteristics. The automotive industry has also received a share of attention with respect to new development. Higher underhood temperatures and higher ignition voltages have led to the demand for materials which would withstand higher voltages at elevated temperatures.

Melamine materials. Melamine materials are formulated with numerous filler, alpha-cellulose, chopped-fabric filled, glass-fiber filled, and mineral filled depending on the characteristics desired. The type filler is primarily selected to produce certain mechanical properties that may be desired; however, care is exercised to select the filler that will allow for the retention of certain paramount properties inherent in the resin. For example, a highly arc-resistant, flame-resistant, and impact-resistant material would naturally be the glass-fiber-reinforced melamine-resin composition.

Nylon. A polycaprolactam-nylon material is somewhat softer than the conventional nylon and may be applicable where squeeze is desired, such as in washers, and its ease of molding larger parts with less difficulty indicates greater possibilities with this type of plastic in the future. It may find its way into the squeeze bottle application in competition with polyethylene, and it is being looked at as a plastic-pipe material.

New extrusion grade Zytel No. 42 has a higher melt viscosity and is designed for extrusion. It is being used in automobile tubing application, the actuator rods for auto radio antennas, and bearings. Films from the new material can be laminated to paper foil and other films. Extruded window channels for autos are expected to be practical with the use of this new product. Its toughness and chemical resistance make it very desirable for aerosol containers. Bottles produced by the blow-molding technique are a promising application.

Resins. Delrin is a new resin based on formaldehyde which is expected to complement nylon. It has very low water absorption, exceptional light resistance, and distorts under a low load of 340 F. The developer has evaluation samples in process, but the commercial production is some time away as yet.

One of the most important developments in acrylics of the past year has been a new type of coating for automobiles which prevents color fading and reduces the need for polishing.

Du Pont is working with methacrylate monomer as a material for fibrous-glass reinforced plastic, in conjunction with dacron, dynel, and orlon fibers for use in post-forming.

Methylstyrene resins, available at about the same price as polystyrenes, but having higher heat resistance, have been introduced. Moldings of this material can be heated in boiling water with ultimate shrinkage of only 0.3 per cent.

Table 8 Mechanical Properties

		General purpose grade	Encapsulation grade	
Gage, in.		—	0.005	0.004
Yield strength, psi[a]	23 C		1350–1750	>2000
	80 C		450– 600	> 500
	120 C		—	—
Tensile strength, psi[b]	23 C		1900–2500	>3000
	80 C		750– 900	>1200
	120 C		100– 200	> 150
Ultimate elongation, per cent[c]	23 C		300– 500	over 200
	80 C		300– 500	over 200
	120 C		200– 600	over 200
Shrinkage at length-wise, per cent	150 C		25	40–50

[a,b,c] All tests run per ASTM standard D-882-54T.

Table 9 Properties of Molded Phenolic Materials

Shrinkage, mils per in.	4–5
Specific gravity	1.73
Water absorption, per cent in 24 hr	0.2
Heat distortion, F	325
Flexural, psi	8500
Modulus in flexural, psi	1.3×10^6
Tensile, psi	5000
Impact, notched Izod, ft-lb per in.	0.27
Compressive, psi	23,000

Table 10 Selected Properties of Urea-Melamine Materials

	Urea-cellulose filled	Melamine-cellulose filled	Melamine-fabric filled	Melamine-glass filled
Specific gravity	1.49	1.49	1.5	2.0
Izod impact, ft-lb	0.28	0.28	0.8	10.0
Water absorption, per cent in 24 hr	0.6	0.5	0.5	0.5
Arc resistance	130	130	120	180

Table 11 Selected Properties of Nylon

	Standard nylon	Polycaprolactam nylon
Impact, Izod, ft-lb per in. 77 F	0.9	1.2
Flexural strength, psi	14,600	15,500
Tensile strength, psi	11,500	9,600
Modulus in flexure, psi	410,000	385,000

Synthetic rubbers. Isocyanate-base polymers, Polyurethane-type rubbers, still of interest primarily in military designs where necessity outweighs cost, hold great promise for the time when fabricating techniques are improved and manufacturing costs are reduced. Such products possess tremendous abrasion resistance. The long-awaited automobile tire which will outlast the car is a possible application.

Hycar synthetic-rubber fuel lines are being applied in autos, running from the gasoline tank to the carburetor, made from a hose based on rubber, rather than conventional metal-fuel line. Some of the newer automobile manufacturers are planning to use a large tank made of Hycar as a hydraulic accumulator in their hydraulic system.

This accumulator is to supply fluid for hydraulic brakes and power steering in the event that the motor shuts off for any reason. Within the next five years, oil-resistant rubber may be used to manufacture fuel cells in autos the same way that these rubbers are now used to make fuel cells in aircraft.

Lexan[6] polycarbonate resin is one of the latest materials.

The properties of plastics have made significant contributions to many industries important to all of us. Many design characteristics of today's familiar consumer and industrial products have been made possible by these special properties. The materials mentioned, together with those now in the test-tube stages, will emphasize the important trends in design, which are miniaturization, the wider use of color, and the importance of chemical properties.

[6] Described in the "Briefing the Record" section of the June, 1957 issue of MECHANICAL ENGINEERING.

* coatings and finishes[7]

Coatings or finishes for engineering materials are used for sealing; to prevent corrosion; to improve electrical, thermal, frictional, abrasion, or wear characteristics; to provide increased strength; or promote better adhesion of other materials—in addition to their appearance value.

They have been divided for discussion purposes into three general classifications: organic coatings, metallic coatings, and conversion coatings.

Organic Coatings

Varnishes and enamels may be either air dried or baked to produce the ultimate physical properties. For general discussion, enamels may be defined as pigmented varnishes. Some of the newer enamels or varnishes are the Epoxy, Hypalon, and Polyurethane types.

Epoxy type. The epoxy type has excellent chemical resistance, flexibility, impact, and abrasion resistance, as well as superior adhesion to all the commonly coated surfaces. They may be formulated to be resistant to most liquid and gaseous industrial chemicals, liquid foodstuffs, acid fumes and splashing, and other destructive agents. Strong mineral acids should be avoided.

They have the disadvantage of poor shelf life; and since most formulations include catalyst-type curing, it creates production problems and is unhandy.

Epoxy coatings are used for such things as collapsible tube finishes, drum linings, electrical insulation, furniture finishes, gas and oil pipe lines, paper, and other similar uses.

Hypalon. Hypalon is another relatively new material that may be formulated either flexible, resilient, abrasion resistant, or as a hard coating. It is a polymer prepared by the simultaneous chlorination and sulfination of polyethylene. These coatings have excellent resistance to sunlight, weather, heat, ozone, a wide range of industrial chemicals, and flexing even at low temperatures. They are inherently color-stable and produce attractively colored films.

They may be formulated by air dry or heat cure at elevated temperatures as desired. Shelf life in the can is fair.

Without modification films are elastic, clear, and glossy but tend to be tacky and exhibit surface drag. This can be helped by blending with other compatible materials.

Hypalon is used extensively as a coating over rubber for protection from attack by ozone and the degrading effects of weather. Some such uses are mats, radiator hose, foam door strips, extruded window seals, boots, sporting goods, textiles, and glass fiber. When blended with polyethylene or epoxy resin, for example, the coatings have excellent abrasion resistance.

Polyurethane. Polyurethane coatings have many physical properties far superior to the standard finishing materials. These coatings are formed by reacting an isocyanate-type catalyst with a polyester resin, polyethers, polyalcohols, or prepolymers and catalysts.

They have good adhesive properties, excellent wear resistance, as well as humidity and weather resistance, and can be formulated to be anything from soft with high elastic properties, to hard with lower elastic properties. Polyurethane may be used clear or pigmented and may be baked or air dried.

Limited shelf life, tendency to discolor slightly on prolonged exposure, allergy hazard from some of the reacting agents are objections, as well as the necessity for mixing with a catalyst before application, and the necessity for moisture freeness to prevent foaming.

The two lacquers which have received most attention in new developments are the acrylic type and vinyl type.

Acrylic resins. Acrylic resins are waterwhite, having excellent transparency and resistance to discoloration as well as resistance to water, alcohol, alkalis, acids, mineral oils, vegetable oils, greases, chemical fumes, and relatively high resistance to burning, as well as having good gloss retention.

As an automobile finish with high metallic and pastel colors, acrylic resins retain high gloss for 18 months to 3 years without waxing, although the cost is high, and spotting is a problem. Chemical resistance and re-

[7] By H. J. Reindl, supervisor, research and development-finishes section, Inland Manufacturing Division, General Motors Corporation, Dayton, Ohio.

sistance to moisture are good at normal temperatures, suiting them to use for can and tank liners.

Vinyl lacquers. Vinyl lacquers have high chemical resistance, and are not attacked at normal temperatures by alkalies, mineral acids, alcohols, greases, oils, or aliphatic hydrocarbons. They have good resistance to moisture, high film strength, and good elasticity when formulated as such.

"Latex" paints. Water and styrene butadiene dispersion paints, known as latex types, are widely popular because of ease of application and other properties. They are most used for household decoration, although their properties suit them to wider applications.

Silicone primers. Water-soluble silicone primers are now available for industrial use which provide excellent water repellency for concrete, brick, stone, cinder block, bridges, and highways. These surfaces give longer life since subsequent penetration by water is greatly reduced and freezing damage is minimized.

Fluorocarbon dispersions. Fluorocarbon dispersions are available for coating a wide range of metals. Teflon, a polytetrafluoro ethylene material, which displays phenomenal anti-stick properties, is fused at approximately 750 F for maximum physical properties. Kel-F, a polychloro trifluoro ethylene material, also displays properties similar to Teflon, but to a lesser degree. It may be fused at approximately 650 F. Both materials must be handled with extreme care as both the material and curing fumes are toxic.

They are still quite expensive and require care and experience to obtain good adhesion to the base material. Typical applications are bearings, baking pans, bobbin guides, tank linings, snowplow blades.

Plastisols. Plastisols, which are mixtures of resins and plasticizers that can be molded, cast, or converted into continuous films by the application of heat, are becoming more and more prominent. If the mixtures contain volatile thinners also, they are known as Organisols. They are usually based on dispersions of polyvinyl chloride, and can be varied in thickness and flexibility. They must be fused at approximately 350 F to produce homogeneous films. Films up to 15 mils can be sprayed, and up to $^1/_4$ in. thick can be applied by dipping a hot, thick metal part. They are usually applied over a varnish-type primer if good adhesion is necessary.

Application methods. Electrostatic application of organic finishes has made great strides in producing better-appearing and performing finishes with less paint. The process is basically one of charging paint particles and attracting them to the article to be painted by grounding the article or oppositely charging it. Some electrostatic processes deliver 95 to 100 per cent of the paint to the article to be painted and cover parts difficult to reach by other methods.

The Hot Spray process or application of coating materials such as lacquers, synthetic enamels, vinyls, and high-viscosity asphaltum mastic with heat has been developed in recent years to make it practical to take advantage of greater speed, economy, and efficiency of spraying. In this method, heat is used to reduce most materials to spraying viscosity without the use of large quantities of "thinners."

The Fluidized Bed Method, which produces coatings of 3 to 15 mils, is a process invented and patented in Germany and recently introduced into the United States. The process consists essentially of dipping a preheated article into a level bed of finely divided or powdered coating material which is suspended in a tank by an ascending current of gas or air. The article to be coated must be capable of being preheated without distortion or decomposition to a temperature above the melting point of the powder into which it is dipped. By proper selection of the coating material, a wide range of products may be coated, such as metals, ceramics, wood, or glass.

Metallic Coatings

Metallic coatings have also received considerable attention in recent development work on both old and new techniques.

High vacuum metallizing has opened new fields of metal-coating applications and replaced some electroplating procedures. By this process, a thin metallic coating ordinarily a few millionths of an inch in thickness can be deposited on the surface of plastic, glass, metal, or painted surfaces.

This metallic coating is applied in a vacuum chamber at a pressure of approximately 1 micron or less, being heated and evaporated, then allowed to condense on all exposed surfaces. It is possible to rotate objects within the vacuum chamber by jigs and fixtures so that all surfaces are exposed.

While aluminum is the usual coating material, sometimes zinc, silver, gold, copper, nickel, tin, and many other metals as well as some inorganic compounds may be applied.

The coating produced is an exact replica of the surface upon which it is formed. Therefore, to produce highly reflective bright coatings, it is necessary to start with bright surfaces.

Second surface coatings can be applied on the reverse side of clear plastics or glass, and the finish viewed through the material.

Conductive coatings. Electrically conductive coatings can be applied to nonconductive materials for many purposes. Some are lacquers containing high metallic contents of silver, copper, or aluminum. They may be applied by spray, dip, paint, or roll. Conductive coatings may also be applied by vacuum metallizing and by the chemical reduction of a metallic salt from solution similar to the silver nitrate method of mirroring.

Wear-resistant coatings. Tungsten carbide may be applied to the surface of a metal by a new process now being developed. This coating generally consists of almost-diamond-hard tungsten-carbide particles applied in a thin coating having excellent wear resistance and fairly good flexibility. The carbide is applied in the form of a powder, and application temperatures are claimed to be low enough to permit aluminum to be coated without distortion. Other details are not available. Typical applications are machine spindles, draw dies, plug gages, and burnishing broaches.

Process Developments. Much work has been done in producing nickel coatings by direct reduction of nickel salts from solution without the use of electric current. The process, particularly promising for special applications, is referred to as "Electroless Nickel." The thickness of coating, ranging from 0.05 mil to 10 mils or more, is dependent upon time immersion. The nickel plate may be heat treated to hardness levels in the neighborhood of 450 Vickers or better. These coatings may contain 5 to 7 per cent phosphorus, and may be applied to steel, aluminum, copper, nickel, and other base

metals. The coatings are uniformly deposited on the base metal and are not subject to the throwing power characteristics of electroplating baths. Typical applications are valves, gears, tube interiors, tank interiors, pistons, threads, and bearings.

Hot-dip metal coatings of aluminum, obtained by immersing a metal part in a bath of molten aluminum, after previous fluxing to obtain adhesion, is receiving considerable attention for coating steel. They seem promising for general use, especially in industrial atmospheres, and for protecting steel from high-temperature oxidation. Hot-dip aluminum-coated-steel sheet, strip, and wire are commercially available.

A diffusion-type coating can be produced by heating a base metal, usually steel, while in intimate contact with another metal in powder, liquid, or gaseous form. This produces an alloy-rich surface layer. Chromized coatings of 4 to 8 mils on steel have corrosion resistance similar to that of high-chromium steel. Temperature resistance is even better than high-chromium steel. These coatings are used on valves, pumps, gages, tools, and parts requiring a combination of wear, corrosion resistance, and high-temperature resistance.

Sheets or plates of corrosion-resistant metals are sometimes welded or brazed to base metals where severe corrosion conditions make necessary a thicker and more economical coating. For some applications, stainless-steel-clad or low-carbon sheets may be used in place of solid stainless. A great variety of clad-metal plate, sheet, strip, tubing, and wire are commercially available. Low-carbon steel sheets clad with textured vinyl and other types of organic materials are also commercially available.

Chromium plating. A new electroplating procedure of applying chromium to a base metal referred to as "nonporous chromium" has recently been introduced. It is claimed to have increased corrosion protection over the standard chromium plate due to its nonporous nature. Coatings of 0.06 mil or better may be applied directly to a base metal, and it is claimed they offer protection similar in some cases to that of the nickel-chromium or copper-nickel-chromium plates used.

Anodizing. The process of producing oxide films on aluminum is usually referred to as "anodizing." These films are produced by making aluminum or an aluminum alloy the anode in an electrolytic bath, usually of sulfuric acid, although many other electrolytes may be used. The coating formed will range in thickness from 0.05 mil to 3 mils and may provide wear resistance, corrosion protection, electrical insulation, base for adhesion of other materials, or a combination of these items.

Since the film formed varies from completely transparent to translucent, depending upon the alloy being anodized and the anodizing procedure used, the preliminary preparation given the aluminum to be anodized will affect the final appearance of the finished article.

Considerable effort has been expended on developing chemical brighteners which will produce a smooth, bright, lustrous finish on the aluminum, by immersion for 1 to 3 min in a chemical bath.

Conversion Coatings

Anodic coatings. Excellent-colored anodic coatings may be obtained by immersing the anodized aluminum in a dye solution, or by chemical precipitation of mineral pigments in the pores of the oxide coating. These coloring materials can then be sealed into the coating by immersion in hot water, dilute nickel acetate, or some other sealing agent. The dyed coatings are satisfactory for indoor applications.

Colored anodized coatings for exterior exposure are now being used extensively where pigmenting of the coating is possible. In this case, iron oxide is precipitated into the pores of the oxide coating from a warm solution of ferric ammonium oxalate.

Extremely hard coatings of aluminum oxide can be produced on some alloys by special treatment in sulfuric acid electrolytes operated at low temperatures (20 to 35 F). Typical applications are pistons, valves, cams, brack disks, computing gears, impeller blades, and nozzles.

Phosphate coatings. Phosphate coatings applied by bringing the base metal into contact with aqueous solutions containing phosphate salts, phosphoric acid, and various reaction accelerators are used extensively for paint adhesion. They may also provide excellent corrosion protection when used in conjunction with oils and waxes. They may be applied to iron, steel, and zinc, and to a lesser extent to aluminum, cadmium, and tin.

Phosphate coatings are also receiving considerable attention as a basis for bonding other materials to iron, steel, zinc, and aluminum in particular. A complex but easily applied phosphate-oxide coating is available for tin. The invisible film is used on tinplate for atmospheric protection and to prevent unsightly blackening caused by sulfur-containing foods.

Protective films. Clear protective films produced on zinc, and zinc and cadmium-coated metals, are quite satisfactory for some applications. These films are usually applied in less than a minute from room-temperature acid-dichromate solutions. By immersion in organic dyes, some of these coatings can be converted into a variety of colors. Typical applications are automotive, aircraft, and ordnance parts.

Paint-base coatings. Chromate coatings developed for aluminum which can be applied in a few minutes from room temperature or warm solutions by immersion, spraying, brushing, or swabbing provide a paint-base and corrosion-protective coating at a cost much less than anodic treatments and can be applied to alloys which are difficult to anodize. These films are used for applications which require good corrosion-protection but little or no abrasion-resistance. They are excellent as a base for paint adhesion and find one of their greatest applications in this field.

Paint-base coatings for aluminum may also be produced by immersion for 10 to 20 minutes in a warm, alkaline-dichromate-carbonate solution. They give better corrosion protection when sealed by immersion in a boiling dilute dichromate solution.

Oxide coatings. Oxide coatings formed on steel at elevated temperatures, approximately 1000 F in the presence of steam, are extremely hard and abrasion-resistant. These oxide coatings are used on cutting tools such as drill bits made from high-speed-tool steel. The oxide coating provides less friction at the cutting face, minimizes welding of chips at the cutting edge, and gives extended life to each grinding of the drill bit.

There are undoubtedly many more recent developments in the field of finishing which deserve mention, and only the general details have been given on those discussed

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Guided missiles call for airborne auxiliary power

systems for purposes other than propulsion

IN AIRCRAFT with rotating engines, it has been relatively easy to use the prime movers as the source for auxiliary power. Even with the introduction of rockets and ramjets, the early vehicles presented simple auxiliary power requirements which could be met by electrical power from batteries. Today, the increased range, scope, and size of guided missiles have spiraled the need for auxiliary power until it can be met only by self-contained and independent sources. The required power may be mechanical, electrical, hydraulic, or pneumatic, or any combination of these. The auxiliary power system concept is less than ten years old; nevertheless, units are now applied to guided missiles, artificial satellites, and inhabited aircraft.

Applications

Guided missiles. In guided missiles, numerous essential functions must be powered by an auxiliary source. Mechanical power is needed for propellant feed pumps or refrigeration, electric power for guidance systems or instrumentation, pneumatic power for pressurization systems, and hydraulic power for control-tab actuation.

Liquid-propellant systems are best adapted to upper-atmosphere guided-missile applications requiring relatively long duration and high efficiency maintained over wide ranges of load and ambient temperature, and where repeated operation is required. These requirements cover a large portion of the field, but it is also evident that solid-propellant auxiliary power systems will in many cases be desirable, particularly for the shorter-duration applications. Gas-turbine and ram-air types of auxiliary power systems can be applied for those missiles operating within the atmosphere. For missiles in which auxiliary power is not required until after launching, ram air provides a simple, reliable source of power.

Artificial satellites. Rapid progress is being made toward the day when the flight of manned orbital vehicles will be a reality. The flexibility of the power system in producing a variety of power with a low weight penalty makes it extremely attractive for use in manned orbital or space vehicles. The occupant of the space vehicle will be dependent on an auxiliary power supply for heat, communication, course correction, pressurization, simulated gravity (if necessary), and many other necessities. In fact, the operator's very existence will depend on the faultless performance of an auxiliary power supply.

In artificial satellites, where a question of storage may be encountered (power may not be required until some time after reaching its orbit), a solid-propellent design offers a most compact and reliable gas generator. This is because of its fundamental simplicity and very few parts (none moving). It is most suited to applications where constant load is required over a temperature range from −100 F to +165 F and where long storage is required without servicing.

Inhabited aircraft. Much of today's thinking is concerned with missiles, artificial satellites, and space travel, and there is a tendency to overlook inhabited aircraft applications for auxiliary power systems. As long as an atmosphere envelops this planet of ours, air-breathing aircraft will be a necessity, and auxiliary power units for stand-by use in emergencies will increase the reliability of these machines and enhance the safety of the pilot. Auxiliary power supplies can minimize the danger resulting from engine failure in high-speed turbo or ramjet craft by providing a dependable source of power to maintain cabin pressure, radio communication, cabin heat and oxygen supply until the pilot can bring his craft to lower levels and prepare a method of escape.

In manned aircraft, where ram air is available at all times when auxiliary power is required, this type of power source is very attractive, although gas-turbine and solid-propellant sources offer many advantages.

The choice of auxiliary power source for a particular application should be governed by the costs to the vehicle in terms of weight, volume, and frontal area increase. The variation in altitude of operation can also play an important role in this decision, particularly for gas-turbine and ram-air systems.

Typical Requirements

General. A multipurpose auxiliary power supply (one that must produce both electrical and hydraulic power), may have requirements to produce 7 to 8 kva ac, 5 to 6 kw dc, and supply up to 9-10 gpm hydraulic flow at pressures in the neighborhood of 3500 psia. In addition, several applications require the lower limit to be zero and that the maximum load for each variable be obtained concurrently. Finally, the required duration of power production may vary from a few seconds to 20 min or more. Requirements affecting accuracy of control, particularly those applicable to electrical output, are severe and in current practice extend from ±5 per cent

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to as low as $\pm 1/4$ per cent on voltage and frequency under step-load changes of 50 per cent or more. Specifications on hydraulic output are less severe. To this must be added the reliability requirements which may be as high as 99 per cent reliable with 99 per cent confidence factor.

Auxiliary power supplies tend toward complexity, and include most, if not all, of the components and systems of a liquid-propellant rocket or turbojet engine, with even more severe requirements in some respects—notably in the tight control or regulation of electrical output and in the need for miniaturized, high-output equipment.

The elements and subsystems which comprise a representative liquid-propellant auxiliary power system are as follows: (1) A pressurizing system, including high-pressure vessels, valves, and plumbing; (2) the propellant—either bipropellant or monopropellant; (3) the propellant feed system, including a pump; (4) a gas generator—a small combustion chamber for producing turbine drive gases; (5) an ignition system—either spark, heated element, or pyrotechnic; (6) a turbine—usually of the single-stage, impulse type; (7) reduction gearing—often in two stages for driving pumps and alternator at different speeds; (8) an alternator; (9) a hydraulic pump; (10) electrical and control systems; (11) a cooling system—for various components, possibly including the gas generator and turbine; (12) insulation; (13) structure and miscellaneous small components.

Weight. The problems incurred in obtaining minimum weight and space are derived from the necessity to "push the design to the hilt." It affects all components and systems and is exemplified by the following: (1) Highly stressed pressure vessels; (2) high-speed, miniature propellant pumps operating with fluids having extremely low lubricity; (3) high-performance monopropellants, some of which are characterized by high gas temperatures; (4) gas generators operating at high temperatures and pressures; (5) turbines operating at high tip and rotative speeds and at high gas temperatures, under operating conditions which are more severe than those applying to other airborne gas turbines—aside from the saving factor of shorter life; (6) alternators and hydraulic pumps operating at high rotative speed; (7) compact and integrated design.

Temperatures. Environmental temperature requirements present another general problem area, especially requirements for upper limits. At present, steady-state temperatures are in the range of 130 to 600 F, with short-time temperatures up to 800 F. These levels will undoubtedly increase—possibly to as high as 1200 F in the not too distant future. When the high-temperature requirement is superimposed upon the need for high output with minimum weight, the effect is to compound the difficulties associated with both. All components are affected but particularly the hot or heat-generating parts such as the gas generator, the turbine, the alternator, and the pumps.

Cooling systems and insulation may help, but not without penalties in weight and complexity. The turbine, gas generator, and other "hot" components may require insulation to prevent their igniting propellant vapors, and under this condition a cooling system may be a necessity to maintain metal temperatures at acceptable levels. Insulation may also be required on the propellant feed system, tanks or valves, and dynamic components to maintain temperatures low enough to avoid mechanical failure or auto-decomposition of the propellant. If thermal lag is not adequate to avoid excessive temperature, then cooling must be provided as well as insulation.

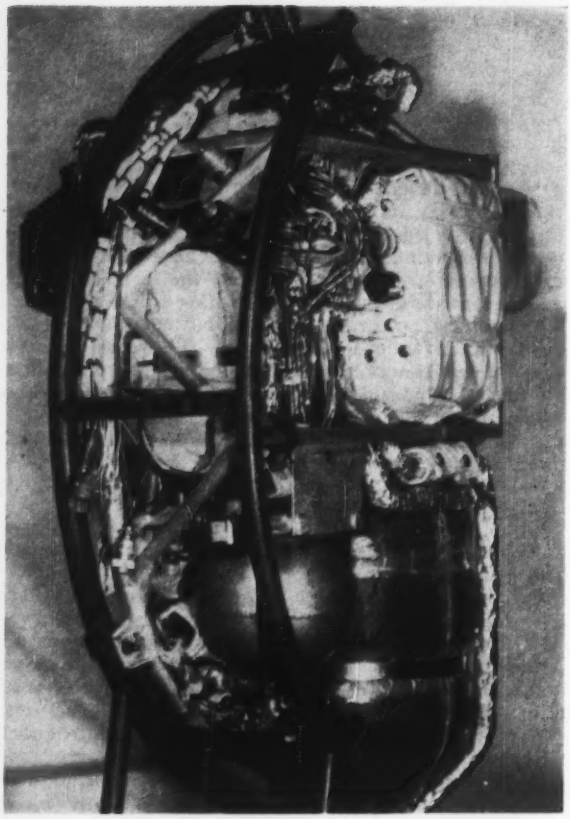
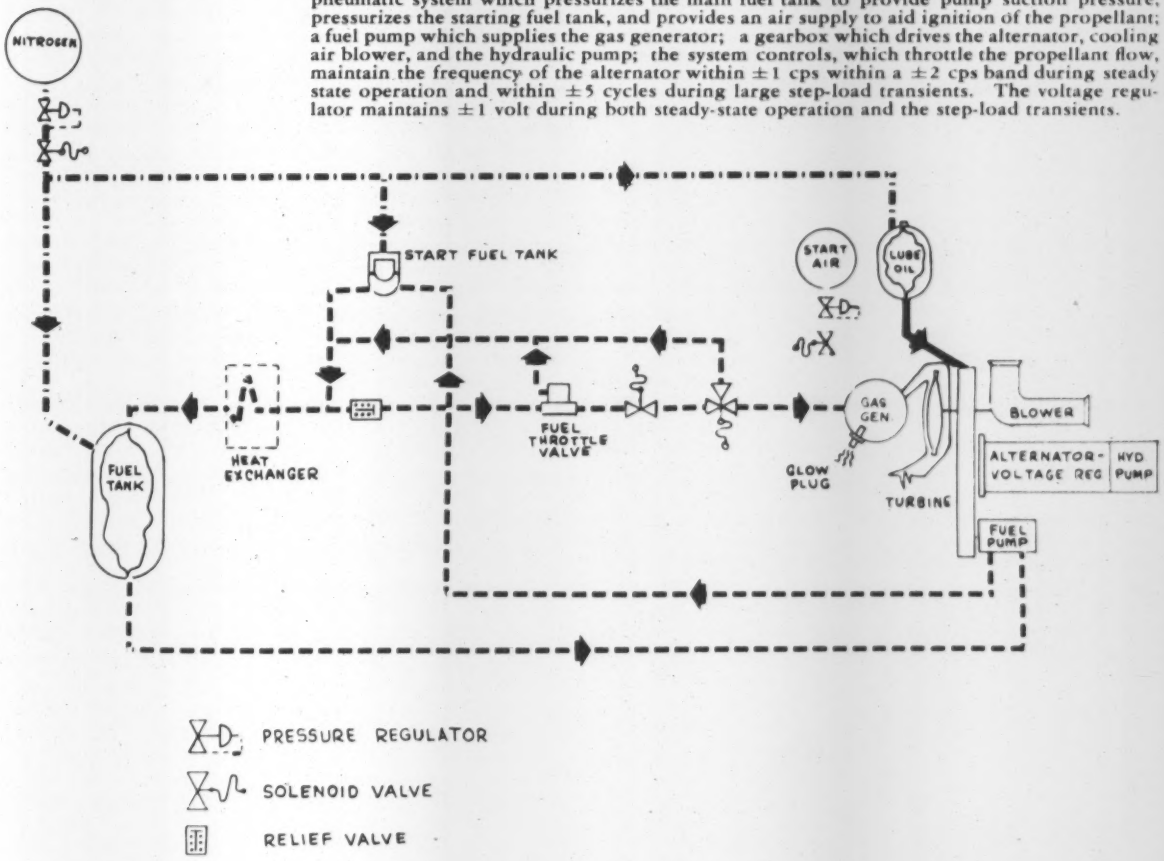


Fig. 1 This liquid-monopropellant auxiliary power system is completely self-contained, weighs approximately 220 lb fully loaded, and measures 18 × 24 × 40 in. This system is shown in simplified diagram in Fig. 2.

Reliability. The reliability requirement for auxiliary power supplies is very high, in some cases up to 99 per cent with a confidence factor of 99 per cent under all of the operating conditions to be encountered in the field. A failure consists not only of any typical component malfunction or failure, but also of any deviation in the outputs from the unit beyond the very tight tolerances which are set. Since safe designs generally involve increased complexity, a larger number of components, close tolerances, and a close control on starting sequences—all of which introduce increased possibilities for failure or deviation from specified operating ranges—this conflicts with the objective of simple systems for high reliability and must be resolved through compromise which will satisfy both goals.

Safety. The safety requirement for auxiliary power systems is basically the same as that for rocket engines; operating safety, under all conditions of single malfunction, sufficient to avoid all hazard to life, the vehicle, and its equipment. Whether or not the vehicle is man-carrying, the hazards are basically the same because the launching of an uninhabited vehicle from an inhabited

Fig. 2 The monopropellant system of Fig. 1. Major elements are: An electrically ignited, self-fed liquid-monopropellant gas generator that supplies combustion gases to drive the turbine; a single-stage impulse turbine which operates at high tip speed; a high-pressure pneumatic system which pressurizes the main fuel tank to provide pump suction pressure, pressurizes the starting fuel tank, and provides an air supply to aid ignition of the propellant; a fuel pump which supplies the gas generator; a gearbox which drives the alternator, cooling air blower, and the hydraulic pump; the system controls, which throttle the propellant flow, maintain the frequency of the alternator within ±1 cps within a ±2 cps band during steady state operation and within ±5 cycles during large step-load transients. The voltage regulator maintains ±1 volt during both steady-state operation and the step-load transients.



area also involves a safety risk. Therefore it may be necessary to incorporate in the vehicle close-tolerance precision elements, which may have a significant effect upon reliability.

A second aspect of the safety problem is the high-speed rotating elements of the system, such as the turbine, which may burst or fail in such a way as to jeopardize personnel or the vehicle.

Characteristics of Typical Systems

Liquid-monopropellant system. Aerojet-General Corporation is presently engaged in the development of several auxiliary power systems, including both liquid and solid-propellant types. Fig. 1 shows a liquid-monopropellant system developing a specific propellant consumption of approximately 10 lb per shaft hp-hr. The major elements of the system are listed and shown schematically in Fig. 2.

Liquid-bipropellant system. A liquid-bipropellant auxiliary power system is shown in Fig. 3 which is being developed currently by Aerojet-General Corporation.

Solid-propellant system. A recently developed solid-propellant system is shown in Fig. 4. This unit is a rugged electrical-power generating system designed for a duration of 85 sec.

In the application for which it was designed, the unit is started by energizing the ignition capacitors from any 110-volt a-c or d-c source and then closing a switch between the capacitors and the igniter. Capacitors are required only for applications in which the auxiliary power unit must be started some time after separation from an external source of electrical energy. Rapid initiation of combustion and production of gases brings the unit up to operating speed in less than 1 sec. The high power required for accelerating is provided by a higher gas pressure during the boost phase.

The output of the alternator is used to actuate the control system, which regulates the speed, maintaining voltage and frequency within the narrow limits specified, and also compensating for variations in load and gas-chamber pressure.

Projected Development Trends

The trend in performance requirements of auxiliary power systems is toward greater severity. Environmental temperatures may be expected to increase to 1000 F or higher. Flight durations will increase, and thereby focus attention on more efficient utilization of energy in auxiliary power systems as the weight penalty for carrying propellant for longer duration becomes a

larger percentage of the total system weight. The requirements for control accuracy will become more stringent; 1/4 per cent accuracy will not be adequate for many future applications.

The present status of development of auxiliary power systems shows certain areas where improvement in performance can be achieved more effectively.

Increased turbine efficiency. Turbine efficiency of existing auxiliary power systems is characteristically low, ranging from 20 to 40 per cent. This is generally true because nozzle flow rates are low and pressures are high in relation to other types of turbo machinery, leading to the use of partial admission nozzles and attendant high aerodynamic losses. Turbine efficiency may be improved in future designs by careful attention to nozzle configuration selection of operating pressures, or using 2 or 3-stage turbine systems rather than single stage.

Higher rotational speeds of driven components. Development of alternators or hydraulic pumps capable of operating at higher rotational speeds is an area which offers potential gains in simplicity of the auxiliary power system as well as weight saving. By increasing the operational speed of such components, thereby bringing them more in line with the favorable design speeds of the turbine, the requirements for reduction gearing may be reduced or eliminated. Typical design rotation speeds of hydraulic pumps in the range of 5000 to 6000 rpm necessitate reduction gearing of 4, 8, or 12 to 1. Alternator design speeds are commonly to be found in the range of 12,000 to 24,000 rpm which in some cases permits direct drive by the turbine. Higher design speeds are dependent not only upon basic mechanical design of the alternator, but also upon selection of the operating frequency for alternating current power. The present usage of 400 cycle a-c power automatically limits the alternator speed to 24,000 rpm. It is to be expected that higher frequency may be in common usage in the future, but the design considerations must include a predetermination of operating frequencies.

Improvement of reliability. Basic criteria for reliability, such as methods of monitoring and analyzing the growth of reliability and of demonstrating that a given degree of reliability has been attained, are being studied. In this area, the aircraft industry in general and the auxiliary power industries in particular are working continuously toward establishment of the necessary reliability standards. Attainment of high levels of reliability will involve substantial improvements in design and in procedures and controls applied during manufacture and operational use. Particular attention to the starting cycle of auxiliary power systems will allow significant gains in reliability since (as in rocket engines and to a lesser extent all types of engines) it is during starting that malfunctions most frequently occur. Once stable operation is attained, reliability is of a significantly higher order. System simplification, improved propellants, and control environments will all contribute to improvements in reliability, and all of these are being considered diligently in the auxiliary power field.

Improved control systems. Considerable progress has been made in control system design, to the extent that 1/4 per cent control of frequency is attainable. Further improvement in the accuracy of the control is to be

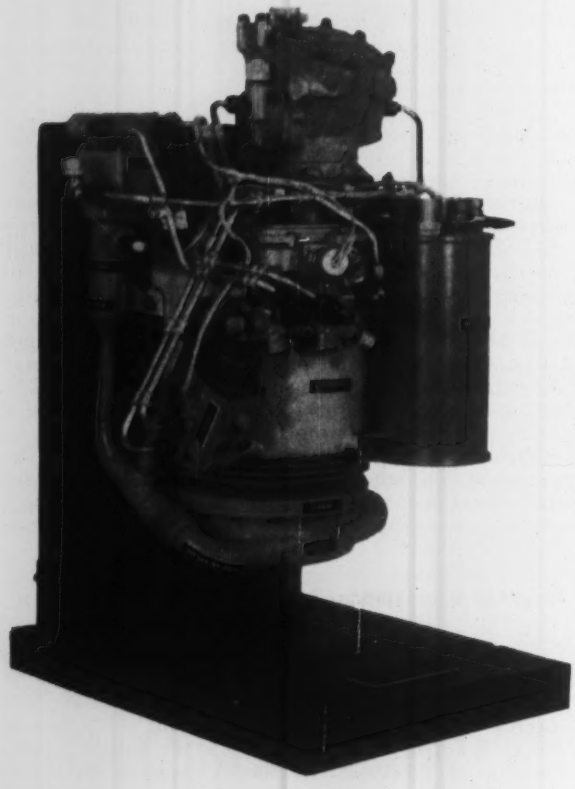


Fig. 3 Shown here is a bipropellant auxiliary power system which may use either a gaseous or liquid oxygen supply. Gases produced by the gas generator drive a single-stage impulse turbine which operates at a relatively high tip speed. Speed is controlled by a bypass valve which regulates turbine inlet pressure in response to an electrical frequency sensing system. Bypass gases from the turbine are used to vaporize liquid oxygen supplied to the auxiliary power system by means of a heat exchanger. The turbine drives a permanent-magnet alternator and variable-delivery hydraulic pump. Reduced speed drive of the hydraulic pump is accomplished through a single set of two spur gears operating "overhung" from the alternator bearings. The bearings require no external lubrication. The alternator has separate sets of polyphase stator windings which produce the required a-c and d-c power. The d-c power is provided by rectifying the output of one a-c polyphase stator winding in a silicon diode rectifier. Voltage regulation is accomplished by means of back windings on the alternator stator. Since the alternator has no brush contacts, operation is unaffected by high altitudes. Control during 50 per cent step load changes is within ±1 per cent on both frequency and voltage.

found in continued development and close quality control.

Improved packaging of auxiliary power systems. Considerable weight savings can be obtained by careful attention to the packaging of the auxiliary power system and physical integration of components within the system. Structural weight may be reduced not only by integration of major components, but also by better orientation of components so that the system assembly possesses inherently better vibration characteristics. Improvements of this nature may be realized, in part, by a redesign of existing systems within the same space envelope, but more effectively in the future by giving adequate consideration to optimization of auxiliary power system space requirements in the preliminary design of the vehicle.

Attainment of high-temperature capabilities. Since environmental temperatures will climb to higher levels, we must depend on increased use of effective cooling, insulation, and material development. In designing the auxiliary power package, components having common temperature sensitivity characteristics can be isolated to realize maximum effectiveness of localized cooling and insulation. For some applications, involving short-duration exposure to peak temperatures, effective use of insulation may alone be sufficient. Development of materials for high temperature use is a continuing and essential need, particularly in the field of nonmetallic materials for O-rings, packings, gaskets, electrical and thermal insulation, and tank bladders.

In order that these potential improvements in auxiliary power system performance may be achieved most quickly, a co-ordinated effort between the auxiliary power system user and developer is a major need. One of the primary factors that has led to the development difficulties at the present time has been the failure to give adequate consideration to the auxiliary power system planning in the preliminary design phase of the vehicle program. Requirements and specifications should be standardized to the maximum extent in order to narrow down research and developmental effort and to reduce manufacturing costs. Requirements for programs involving deliveries on a fixed time scale should be set realistically but never beyond actual needs. These requirements should be continuously re-evaluated and readjusted downward wherever feasible. Where short time schedules are essential, it is necessary to set initial requirements for weight and performance at interim goals so as to insure deliveries on schedule. Increases in the severity of the requirements should be scheduled in planned steps for product improvements. In regard to reliability requirements in particular, it should be noted that any lessening of the operating temperature ranges or other environmental requirements can have a major effect upon the attainment of reliability. The effect of the severity of requirements is significant not only directly in terms of decreased reliability but also in terms of increased cost and development time.

It further appears essential that a co-ordinated program of basic long-range research be established to resolve major problems and to insure steady advances in the "state of the art." Such a program should include research in liquid monopropellants and solid propellants; materials, both metals and nonmetals; and fundamentals of component design covering alternators, hydraulic pumps, turbines, cooling systems, and ignition systems.

Fig. 4 This is a solid-propellant system, weighing 40 lb, fully loaded, and fitting a space envelope of approximately 10 × 10 × 6 in. The alternator is directly connected to a gas turbine, which is driven by hot combustion gases from solid propellant. The unit will operate over a wide ambient-temperature range, and it can be stored for long periods of time in the ready condition.

Conclusions

Recognition of the need for airborne auxiliary power systems has grown as an exponential function, in recent years, after the realization that aircraft must employ new means of propulsion in order to attain the rapidly expanding goal of higher speeds and higher altitudes. In part, the lateness of this realization is attributable to the fact that we have been able to take auxiliary power for granted. The auxiliary power system constitutes a new and growing component, an essential element in our long struggle to advance the technological frontiers of our time.

The number and broad range of present requirements for auxiliary power systems are conclusive evidence of the importance of this type of equipment as an essential component of missiles, and it appears that similar requirements may become equally well established in the near future for inhabited aircraft as a source of emergency power. Although the concept is less than ten years old, remarkable advances have been made.

It is a highly specialized assembly of precision components, and although relatively small in size, it requires an engineering effort of large magnitude to design and develop—an effort, in fact, of the same order of magnitude as that required for developing a liquid rocket engine. The greatest problem in this field could well be a failure to recognize the scope of the engineering task involved.

The potential of the auxiliary power system for improving performance to meet the growing challenge of increased requirements is commensurate with the need to meet that challenge. Ways and means of improving performance are being attacked vigorously. Some of the paths to improvement are clearly defined; others are in the process of being defined. The auxiliary power industry is confident of its ability to make significant contributions to the technical progress essential to the national defense and the advancement of science.

A Versatile Drive

To begin a study of various methods of power transmission, investigating their approach to a desired performance, a first step is to consider the ideal transmission. If speed and torque ratios are fixed between a prime mover and the load, the simplest and most economical arrangement is a fixed-ratio drive which can be adapted precisely to the operating ratios. Such a transmission is limited in its approach to the ideal only by the efficiency of the drive itself. But for variable ratios, study is based on an ideal curve. In Fig. 1, curve A shows the optimum in power transmission, an infinite number of speed ratios at 100 per cent efficiency through a complete range of speed.

Fig. 1 The criterion. The optimum power curve; transmission assumed to be 100 per cent efficient. The product of speed ratio and torque ratio always equals 1.

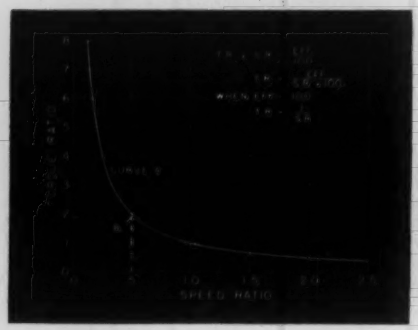


Fig. 2 A three-speed mechanical transmission, with the ability to multiply torque three times, shown in relation to the optimum power curve

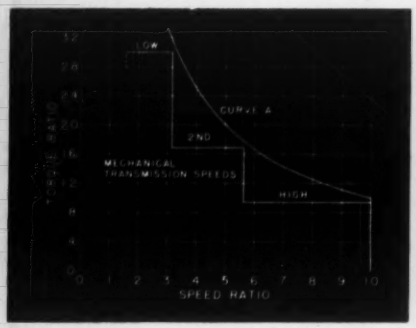
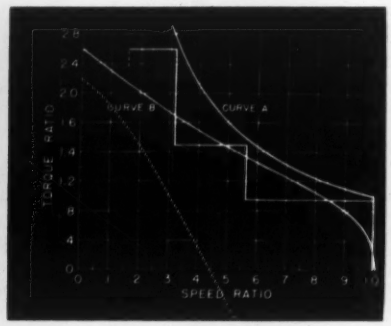


Fig. 3 Enter the hydraulic torque converter, a smooth power curve over the speed range. It may have 90 per cent max efficiency.



Hydraulic torque converters

By H. L. Willke,

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The hydraulic torque converter is acquiring new stature as a means of transmitting power from a prime mover to a varying load. In trucks and tractors, locomotives, logging machinery, hoists and cranes—wherever high torque and wide speed range are required—the half-century-old torque converter now enters a new era, particularly in combination with mechanical transmissions. Dumping valves, freewheeling stators, lock-out clutches, and partial filling contribute to the converter's new utility. Basic advantages are flexibility, shock-absorbing ability, and mechanical simplicity.

In the case where ratios are fixed between prime mover and load, and transmission efficiency is assumed to be 95 per cent, the power transmitted could be represented by a point such as B, which approaches curve A. Such drives appear in alternating-current power-generating plants, many centrifugal-pump installations against fixed conditions, and drives for ocean liners which cruise at relatively fixed speeds and loads.

For variable loads, the earliest established and still prominent drive is the multispeed mechanical transmission. Its approach to the optimum power curve is shown in Fig. 2. Here again, the assumption has been made that the transmission can be 95 per cent efficient; but with a substantially constant-torque prime mover, the mechanical drive can deliver 95 per cent of the power capacity at only one point for each of the speeds. During all other parts of the speed range, the engine is being pulled down in speed, but it cannot materially increase the torque, so it fails to deliver sufficient power until the next lower transmission speed can be engaged.

The Torque Converter

In Fig. 3, curve B shows the power delivered by a hydraulic torque converter, superimposed on the previous curves. Since a torque converter with a 3-to-1 torque ratio can be built to have 90 per cent peak efficiency, the power delivery approaches the optimum power curve

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almost as closely as the mechanical multispeed transmission, and maintains this closeness over a considerable span of speed ranges.

It is for loads that vary rapidly back and forth through these speed ranges that torque converters are most effective, providing an infinite number of speed ratios. They keep engines at substantially their maximum power-generating capacity. Unfortunately, the efficiency of the hydraulic torque converter cannot be maintained throughout the speed range. The torque drops to zero at a speed ratio of 1; as the speed ratio approaches zero the torque output increases, but not as fast as the output speed is reduced. But within the working speed range, a mechanical transmission would have to have ten speeds to exceed the performance of the torque converter. To manipulate ten speeds so as to transmit maximum power would be so difficult for the operator as to call for automatic speed changes which, for heavy-duty industrial-type service, might be unsatisfactory. A more practical comparison would employ a mechanical transmission of 5 speed ratios, but even then, in the ratios between 0.35 and 0.9, the gears are hardly a match for the torque converter.

this wide variation, a simple three-speed mechanical transmission would pull the engine down too much in speed, causing it to stall.

A torque converter with supplementary speeds either manually or automatically shifted has applications that encompass all sorts of vehicular drives, such as trucks, rubber-tired and crawler-type tractors, and locomotives. Other examples are logging machinery, oil-well drilling rigs, hoists and cranes, mining machinery, and any situation where large torque ranges and large speed ranges are required.

Fig. 4 The three overlapping curves of a torque converter in combination with a three-speed transmission. Practical ratios are shown here; in the middle is a direct drive.

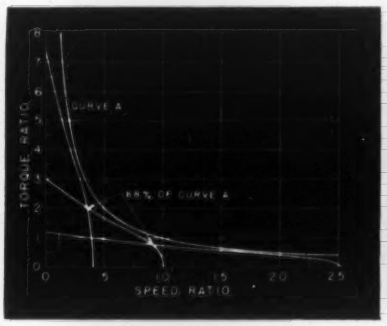


Fig. 5 Theoretical study of the hoisting operation of a drilling rig, removing drill from a 15,000-ft oil well, with successive load reductions of 2400 lb. Normal six-speed transmission is compared with torque converter with four-speed gear box.

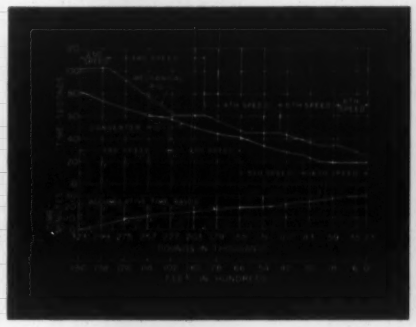
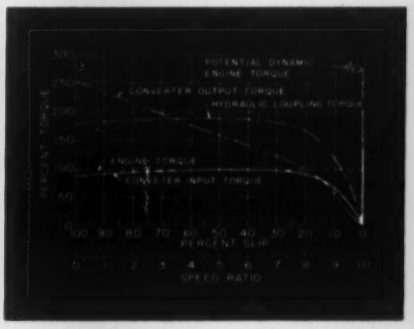


Fig. 6 Relative shock transmission of hydrodynamic drives, giving a direct comparison between a torque converter and a hydraulic coupling. A curve approximating a dynamic load for a mechanical drive has been superimposed.



Combining the Transmissions

Where higher torque ratios are required, or better performance toward either end of the speed range, the torque converter can be combined with a multispeed transmission, resulting in greatly improved characteristics. Should the load require only high torque ratios, a single-speed ratio adapted to the output of the converter may suffice, and torque ratios up to 15 or 20 to 1 are not uncommon. Similarly, for loads requiring higher speed ratios, a single speed-up ratio could be used to obtain speed ratios up to 5 or 6 without any material complexity.

However, such extremes are rare. For a study of a three-speed supplementary transmission, Fig. 4, more practical ratios are considered. The overlapping curves show net results closely approaching the optimum curve. A six-speed transmission to cover this same range would transmit only 52 per cent of the prime mover's power at its minimum points. Again it is obvious that, by adding more speed ratios to either of these drives, the approach to the optimum curve can be improved. For a load of

The Hidden Factors

Up to this point, fuel has been ignored, efficiency being discussed only as it concerned delivering the potential power of the prime mover to the load. Fuel consumption is a factor which cannot be analyzed theoretically because of the many variables. But it is frequently observed that, in spite of lowered mechanical efficiency, the torque converter keeps the prime mover operating in such a favorable condition under all load variations that the effect of lowered efficiency is offset. Instead of the fuel going out the stack in the form of smoke, it is converted into useful work, and on a variety of loads a five per cent increase in fuel usage has resulted in as much as 15 per cent added work done.

Time may be an important factor. Even though the amount of work done is not increased in proportion to the increased fuel consumption, the amount of work done per unit of time may be increased. An oil-well drilling rig is an excellent example. Total investment for a drilling rig may exceed $2 million, the operating expense may be more than $2500 per day, and it is frequently necessary to withdraw the pipe from the hole to replace the drilling bit when it becomes dull. Fuel is an almost insignificant expense.

Fig. 5 is the theoretical comparison between a mechanical rig and a torque-converter rig, and it shows an over-all time saving of 25 per cent in the hoisting operation, a total saving of 30 min for the 15,000-ft trip. This could mean a saving of $52 in time only, in a single trip from the bottom of the hole. Time for hoisting of each of the 120-ft sections of pipe is plotted against the depth of the well, with curve X illustrating the ac-

cumulated time saved by the converter drive as against the mechanical.

But the hoisting function is not the torque converter's only contribution to oil-well economy. The greatest amount of power is consumed by the slush pumps which circulate a drilling fluid down through the drill pipe, and up through the annulus around the drill pipe to remove the bore cuttings and condition the hole. The operation takes nearly as much power as the hoisting function, and it extends over a much greater length of time. The slush pump is a slow-speed reciprocating-type pump, and its load change is brought about by the deepening of the hole. Thus its load change occurs at a slow rate. The common method of adapting the slush pump to its pressure-volume changes is to reduce the piston area by replacing the removable liners and pistons with smaller sizes.

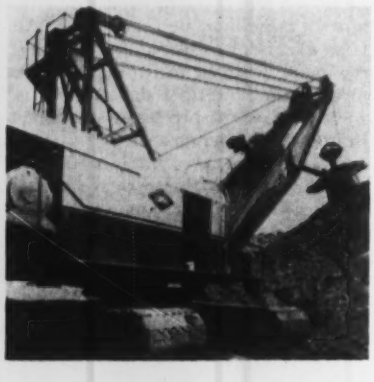
The advantage of a pump driven by a torque converter lies in the fact that it can use a single liner and piston size from the top of the hole to total depth, as against a three-liner program for the mechanically driven pump. Economically, this is a considerable advantage, because it reduces the down time of the slush pump while pistons and liners are being changed. It also reduces the inventory of parts. Common practice calls for altering the size of the fluid nozzles at the drill bit, and this is done for the mechanically driven pump along with the liner changes. With the torque converter, the nozzle change alone makes it possible to maintain almost a constant horsepower throughout the drilling of the well, even though volumes and pressures vary considerably.

Thus the slush pump is an application for the torque converter. Though the converter cannot accomplish quite as much work, or do it quite as efficiently, gains from other sources such as reduction of down time, reduction of parts inventories, and its flexible range during emergencies have made it a desirable drive.

Shock Absorption

Another application for converters is the drive that must withstand severe shock, where the mechanical drive experiences extreme difficulties. An outstanding example is the power shovel. The load variations on power shovels are far too complex to analyze. In general, power-shovel management feels that the torque converter is accomplishing approximately 15 per cent more work at the penalty of 5 per cent more fuel, which in itself favors the torque-converter drive over the mechanical drive. However, it is felt that the converter's principal contribution to power shovels has been in the form of savings in maintenance due to reduction of shock.

Fig. 6 demonstrates the shock-absorbing ability of the converter against that of other drives. During shock, a mechanical drive fails to limit the inertia values of the engine at all. The simple hydraulic coupling provides slip, and is therefore softer. But the converter is even softer against shock. It is proportioned so that its peak power-absorbing ability matches the engine's designed torque rating; therefore, regardless of sudden load application strikes to the output shaft, the demand on the engine can only be for its rated torque, and the effect of the engine's inertia is isolated. The torque converter appears to have a wide margin of shock absorption over other types of drives, and the shovel application is proving this fact in practice.



Exploiting the torque converter's ability to absorb shock. Transmitting 500 hp to the $5^1/_2$-yd dipper of a coal-stripping shovel near Jasper, Ala.

Modifications

The torque converter is flexible in still another sense; with the addition of various modifications, new functions become possible. Industrial converters are now available with dumping valves and controls which make it possible to use the converter as a disconnect clutch by quickly emptying and refilling the working circuit.

Torque converters with free-wheeling stators have been designed, which give conversion during periods of load variation, and provide hydraulic coupling during periods of high-speed low-torque requirements. A good example of the use of this type of converter is an earth-moving scraper where high torques are required during loading periods, and low torques are needed during the hauling phase. The free-wheeling stator, changing the converter into a hydraulic coupling, performs the high-speed operation at a considerably increased efficiency.

Another possible feature is the lock-out clutch. Here, again, the converter is used during changes of load; then, the input and output sides of the converter can be clutched together to serve as a straight-through drive. This can be accomplished either with the converter filled or emptied. If the converter is allowed to remain full, the drag of the elements through the fluid will represent a loss of only five to ten per cent, but the converter is kept instantly available for either type of drive. Where fewer maneuvers permit the emptying and filling of the converter, the drag loss can be eliminated.

Where speed must be brought below the minimum speed of the prime mover, there is the new device of running the converter partially filled. The conventional torque converter can be brought to stall if the torque load on the output shaft is sufficient; partial filling makes it possible to reduce the output-shaft speeds below the stall speed, even under light load.

Currently there is available a single-stage torque converter in which turbines are provided for both forward and reverse rotation, turbines being shifted in and out of the circuit, mechanically. Earlier designs incorporated two circuits which were put into service by alternately filling and dumping the circuits.

These features, singly and in combination, superimposed on the basic characteristics of the torque converter, have greatly extended the utility of the converter, making it a likely choice for applications where it had previously been disregarded.

Development of **engineering managers** *through planned education and training*

1 What are the important management characteristics we are trying to develop?

2 What are the uses and limitations of educational programs for this job?

3 How can we devise and maintain an integrated over-all program of education and on-the-job training?

By **Melvin Anshen,**[1] Carnegie Institute of Technology, Pittsburgh, Pa.

ALTHOUGH it is difficult to define with precision what management is, and any program of management development should be considered tentative and subject to revision, there are certain broad goals that are clear. Educational and training programs should help men to lift their thinking above technical issues, to see the interrelations of the parts of a functioning enterprise, to understand the economic and social process in which business operates and to which it must adjust, to grasp the elements of individual and group motivation.

Programs of Study

Two types of current programs deserve study: Those sponsored by universities, with participants nominated and financed by their companies; and those sponsored by individual companies for their own management people. For reasons of personal familiarity, the author will take, as an example of the first class, the Program for Executives offered by the Graduate School of Industrial Administration at Carnegie Institute of Technology, and, as an example of the second class, the Bell System Executive Conference operated by the American Telephone and Telegraph Company and the associated Bell System companies.

Neither of these programs was designed solely and explicitly for engineers. But both have had a large number of participants with engineering backgrounds, and the planners of both programs were therefore forced to think about the problems of developing engineering managers.

Carnegie Program for Executives

The Carnegie Program for Executives was designed primarily for men who are being prepared for early advancement to senior management positions. It seeks to encourage the development of the following capacities:

1 Ability to take a company-wide view of operating problems—to see the interrelations of production, marketing, finance, engineering, research, and personnel functions.

2 Understanding of the human problems of business organizations—capacity to work with and through people, to win their loyalty, and to direct and strengthen their co-operative effort.

3 Skill in organizing and analyzing facts for decision making—the tools and procedures of quantitative control in business operations.

4 Understanding of economic and political problems—the economy-wide environment in which business managers make and execute their policies.

The Carnegie Program is not aimed at making a man more effective in the technical phases of his present job, although it may contribute to this result. Rather, it is aimed at opening his mind to the complex world within and outside his business organization, the world in which management's decision making is carried on. In this environment, it then encourages him to think through important and characteristic management problems. The encouragement comes first through presenting him with the raw material for thinking in the form of problems and cases drawn from actual business experience, in the fields of private enterprise and public administration. The stimulus to use this raw material is provided by bringing together a thoroughly diversified group of executives; diversified in industrial background, in functional specialization, in size of company, and in geographic location. The men find in this diversity a biting challenge to accepted ways of looking at problems, encouragement to conceive and take under critical examination new possibilities in familiar settings, invitation to look beyond functional boundaries to the co-ordination and integration of departmental interests which are prime managerial functions, and stimulation to think broadly about what is going on in the economic and social environment in which management operates and about the impact of economic and social change on management's decisions.

Clearly, this is a skill-development program only to a limited extent. The omission of attention to certain skills, the effective exercise of which can aid managers materially, should not be taken as negative comment on

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their importance. Skills in communicating, both orally and in writing, and skill in conference and committee leadership can be important aids to managers. The relatively limited attention given to them in the Carnegie Program represents a judgment that considerably more time than the nine weeks of the course is required to produce significant skill development in these areas.

Bell System Executive Conference

Several large companies have organized management-development programs in recent years and it seems probable that the number will increase. The Bell System Executive Conference was one of the first and will serve as a model for this discussion. This program currently operates in two parts: A basic 4-week course, and an advanced two-week course open about 2 years later to men who have completed the basic course.

The basic course has as objectives: (*a*) Broadening the thinking and outlook of telephone-management people sometimes spoken of as "opening up holes in their heads"; (*b*) increasing their present effectiveness; and (*c*) stimulating their interest in further self-development. These objectives are approached through study of the organization and behavior of the national economy, review of how common management problems are handled by companies in other industries, and discussion of general telephone policy issues. The advanced course undertakes to bring this broadened outlook (fostered by voluntary reading and discussion in the time between the two courses) to bear on top-level management problems in the telephone business.

It is interesting to observe that the Bell program, like Carnegie's Program for Executives, does not concern itself primarily with either the technical aspects of participants' current jobs or communications skills. The emphasis is on encouraging a broader view of the decision-making function that is management's most characteristic and important activity, and using a problem orientation to give participants practice in decision-making. It is also worth observing that the essential philosophy and ingredients of the Bell System Executive Conference have been carried into comparable development programs for lower-level management people including a large proportion of engineers in individual telephone-operating companies throughout the country.

Relative Merits of Methods

The concurrent development of university and company programs aimed at advancing management capacity through formal educational techniques raises questions about the values and relations of the two approaches. The following conclusions reflect the judgments of men who have been organizers, observers, and participants in both types of programs:

1 The most valuable aspect of the university program is its assembly of a diversified group of men of outstanding performance and strong potential for further management growth. This type of program strongly emphasizes the constructive development of participants by participants, assisted, of course, by stimulation and guidance from attached faculty personnel.

2 The most valuable aspect of the company program is that it can be organized on a scale to handle all executives at selected management levels. The limited capacity of the better university programs compels them to restrict admission, and the desire to build diversity in each class necessarily reduces each participating company's representation to one or two men per session. The scale of the requirements for management development in the United States far outruns the enrollment availability in university programs. Part of this deficiency can be supplied, under qualified circumstances, by company-sponsored programs.

3 The most serious difficulty in using university programs, beyond the absolute limitation on the number of men they can handle, grows out of the problem of selecting men of outstanding potential as participants without creating unsettling disturbances in organizational relationships and morale. Men passed up in the selection process may see the choice as a judgment of career limitation. Men selected may entertain expectations that cannot always be realized.

4 The greatest weakness in company-sponsored programs is their parochial atmosphere, encouraged by the absence of men with other backgrounds, experiences, and viewpoints than those accumulated within the sponsoring organization. This deficiency may be intensified if the faculty and staff do not draw heavily on outside personnel.

These conclusions suggest that the two types of programs should be viewed as complementary and supplementary rather than as alternatives. A large organization can make effective use of both, relying on the company program to assist in developing a complete horizontal slice of management personnel and on university programs for a broader development mission for selected individuals of outstanding promise.

An Integrated Program

One further consideration is important in connection with the use of either type of program. Management development cannot be pursued effectively through formal educational activities alone. In fact, there is serious danger that planned educational programs—whether university or company-sponsored—may lead to substantial waste of money, time, and effort, and may even generate harmful side effects in relation to expectations and morale, if formal educational activities are not projected within the comprehensive framework of a total management-development program.

Such a comprehensive program begins with a forward estimate of management requirements, detailed by time periods, levels, and principal skill requisites. The second phase in building a comprehensive program is the analysis of current management resources at defined levels, including resources that will become available for use through time. Comparison of needs and resources leads to the third phase—spelling out development requirements. A comprehensive program should aim at building an integrated development activity that makes effective, related use of all educational and training devices. Specifically, this means (*a*) rotation of job assignments to build technical skills, breadth of experience, and adaptability; (*b*) assignment of planned growth in management responsibilities, with observation of performance and coaching by superiors; and (*c*) intermix of on-the-job experience with formal educational projects, in which educational elements are normally designed to prepare men for heavier and broader responsibilities, while job experience is directed to testing and exploiting ability to perform in specific situations.

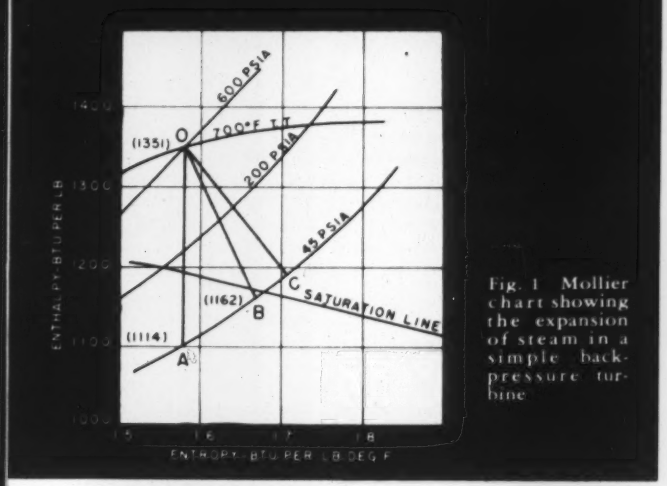

Fig. 1 Mollier chart showing the expansion of steam in a simple back-pressure turbine

Allocation of Heat in an Industrial Power Plant—A Practical Approach

A simple and accurate method of determining the cost of heat energy for power generation and process uses

By Ronald J. Martin,[1] **Mem. ASME**

Beaunit Mills, Inc., Elizabethton, Tenn.

In an industrial plant, an accurate allocation of heat energy between electric power generation and process uses and the apportionment of process heat energy between departments is necessary, not only for internal cost purposes, but also to assist management in deciding between self generation and the purchase of electric power. The power engineer is usually called upon to furnish the proper figures to the cost accountants. Where the cost of steam is between 2 and 5 per cent of the total manufacturing costs, accuracy within 10 per cent will not affect cost allocations between departments materially, although closer determinations are desirable.

However, the quantity of heat charged to power generation affects the cost of power directly. The establishment of a method to compute this figure accurately with a minimum of metering equipment is the purpose of this paper.

There are many "schools of thought" on this subject. Some claim that a steam turbine should be charged with the cost of all steam which passes through it, and that the exhaust and/or extracted steam should not be charged to process. There are others who maintain that a steam turbine should be charged with the heat required for "straight-condensing" operation in which instance process is charged with only a portion of the heat it actually consumes. Still others contend that a steam turbine is solely a reducing valve and that only steam which is actually condensed should be charged to power generation.

Obviously, these are extreme cases; most plants allocate heat on a Btu basis, and that is the method considered here. In studying the economics of power generation, the additional cost for process equipment in departments which utilize steam at lower pressure and require higher investment for larger heat exchangers, larger pipe sizes, and other special equipment, should be totaled with the increment cost for equipment needed to generate power, and any savings should be weighed against this total investment. In all instances, heat is measured as contained in the steam from the boilers, because steam costs are usually computed as net costs from the boiler plant and charged as such.

Theory

What happens to the properties of the steam as it passes through a steam turbine? Fig. 1 is a section of a Mollier diagram showing the expansion of steam in a simple back-pressure turbine. Initial steam conditions are 600 psia and 700 F total temperature (TT). Enthalpy of the throttle steam is 1351 Btu per lb. In a perfect engine steam will expand adiabatically to the exhaust pressure of 45 psia. On the chart this is vertically downward at constant entropy, line OA. Enthalpy of the exhaust is 1114 Btu per lb. This is called the Rankine cycle. In other words, the steam gives up the maximum possible energy to be converted into mechanical power, in this instance 1351 minus 1114 or 237 Btu per lb. Our perfect engine is frictionless and loss-free. The thermal equivalent of 1 kwhr is 3413 Btu. The theoretical steam rate (TSR) of our engine will be 237 divided into 3413 or 14.4 lb of steam per kwhr.

A steam turbine is not frictionless and there are other losses. Furthermore, the steam does not give up all heat possible, but because of friction and turbulence during expansion, heat and temperature changes take place and the steam actually expands along the line OB or OC, with increase in entropy. Less than the ideal or maximum possible heat is converted to mechanical energy.

The ratio of the actual heat drop to the theoretical heat drop is called the Rankine-cycle efficiency and, in industrial turbines of the size we are considering, varies between 40 and 80 per cent depending on load, size,

[1] Manager of Utilities.

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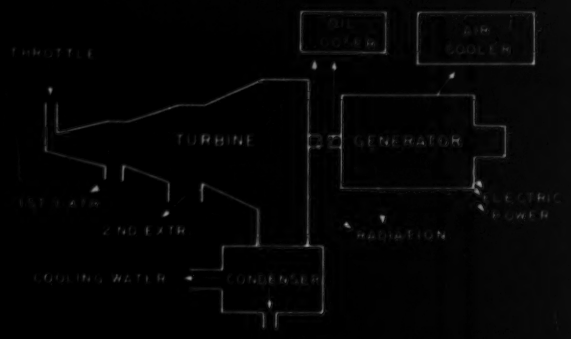

Fig. 2 Turbine schematic showing the flow of heat in a double-extraction condensing steam turbine

Fig. 3 Heat balance per kwhr for a 5000-kw 600-psia 700-F TT turbogenerator extracting about 40,000 lb per hr at 200 psia, extracting about 80,000 lb per hr at 45 psia, and with a flow of 60,000 lb per hr to the condenser

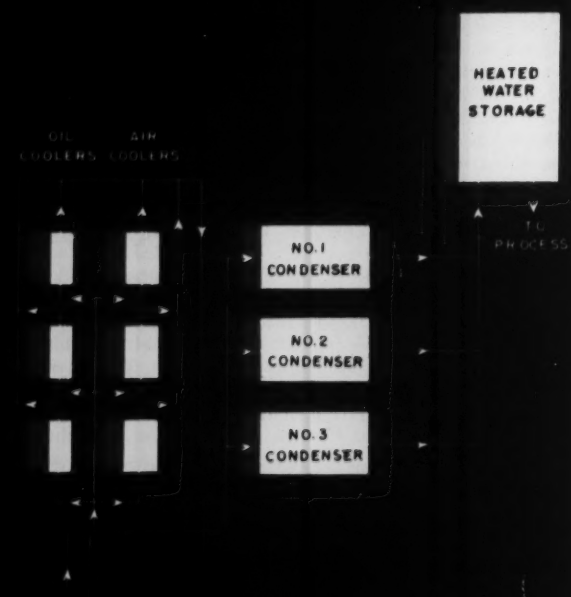

Fig. 4 Heat recovery schematic illustrates how water from the treatment plant passes through the condensers to storage tanks which supply all hot-water requirements

and initial steam pressure. This will be discussed later.

Assume that our actual turbine requires, say, 3600 Btu in shaft energy to produce 1 kwhr, and that Rankine-cycle efficiency is such that steam expands along line OB to 1162 Btu per lb. Heat drop is 1351 minus 1162 or 189 Btu per lb. Actual steam rate is then 189 divided into 3600 or 19.67 lb of steam per kwhr. This value is the steam rate furnished by turbine manufacturers. It varies with the load.

Heat Accounting and Recovery

What happens to the heat which enters a turbine at the throttle? Fig. 2 represents a double-extraction condensing steam turbine and will illustrate all possibilities.

Steam containing energy in the form of heat (enthalpy), measured in Btu per lb, enters the turbine at the throttle. It passes through the first section of the turbine where the drop in enthalpy is converted to mechanical energy. Part of the steam is extracted at the two bleed points. The balance of the steam flows through the turbine with a drop in enthalpy equivalent to the heat converted to mechanical energy. Finally, this steam flows into the condenser where the latent heat is transferred to the condensing water and the heat of the liquid is returned to the boilers.

The heat extracted at both bleed points is chargeable to process. The heat in the condensate is chargeable to the boilers. The radiation losses, the friction losses picked up in the oil cooler, the electrical and windage losses picked up in the air cooler, and the energy as electric power, 3413 Btu per kwhr, is chargeable to power generation. Likewise, where the heat rejected in the condenser is wasted, this energy is chargeable to power generation. In some instances, to be dealt with later, all or part of the heat picked up in the oil cooler, the air cooler, and the main condenser, may be utilized for process and is not charged to power generation.

Fig. 3 shows in block form the relative values of the heat energy for a particular set of conditions. This is a typical chart and depicts the relative magnitude of the components shown in Fig. 2, for specific conditions.

Consider the question of heat recovery. A large number of industrial plants utilize the main condensers to preheat process water, at least a part of the year. Fewer plants recover the heat from the oil coolers and air coolers, although it is possible to recover most of these losses. In a plant with 15,000-kw load annual savings in excess of $3600 per yr are possible. Fig. 4 illustrates how this is accomplished.

Heat Charged to Power Generation

From the foregoing discussion it is seen that the heat charged to power generation is made up of the following components: (*a*) Radiation losses; (*b*) friction losses; (*c*) electrical and windage losses; (*d*) electrical energy produced, 3413 Btu per kwhr; (*e*) heat rejected in the condenser. The radiation losses, *a*, are very small in a well-insulated turbine. The magnitude is within the accuracy of the other components and may be neglected.

The actual shaft power that is converted from heat energy to mechanical energy in the turbine is represented by *b*, *c*, and *d*. In other words, it is the actual loss in enthalpy of the steam in passing through the turbine.

The latent heat of the steam which is transferred to the cooling water in the condenser is item *e*.

Assuming that there is no recovery of heat in the air cooler, oil cooler, and the main condenser, then we arrive at the formula for heat chargeable to power generation:

Btu for power generation = kwhr $\times$ K_1 + condenser flow − lb $\times$ K_2. K_1 is related to *a*, *b*, *c*, and *d* and is called the kilowatthour factor. K_2 is related to *e* and is called the condenser factor. It is only necessary to determine K_1 and K_2.

Kilowatthour factor. One kwhr is equivalent to 3413 Btu. The radiation, friction, electrical, and windage losses may be obtained from turbine designers and for the particular machine. The sum of these two values is the factor K_1. It is the heat which is converted to mechanical energy in the turbine.

The chart, Fig. 5, shows typical total losses in Btu per kwhr plotted against per cent load. Radiation, friction, and windage losses are about constant for all loads; excitation losses vary slightly with the load, and stator losses vary pretty much as the square of the load. Hence the curves take on their peculiar shape. These curves are for data furnished by a manufacturer for turbines ranging from 3750 to 12,500 kw. As will be noted the losses are higher in the smaller machines.

If the losses are added to 3413 we obtain the Btu required to generate 1 kwhr. The curve, Fig. 6, is a plot of Btu per kwhr versus load. For all practical purposes this ranges from 3700 Btu per kwhr at 40 per cent load to 3500 Btu per kwhr at full load. Where there is no heat recovery in the air and oil coolers, this is K_1.

Where heat is recovered from the air and oil coolers, the factor varies from 3460 Btu per kwhr at 40 per cent load to 3443 Btu per kwhr at full load, and for all practical purposes K_1 may be considered 3450 Btu.

Condenser factor. The determination of the condenser factor K_2 is not too difficult. The turbine designer can be of material assistance.

A typical curve showing the enthalpy of the steam at the extraction points of a double-extraction turbine versus steam flow in the several sections is shown in Fig. 7. This information may be obtained from the turbine manufacturer. This particular curve is for a 5000-kw 600-psia 700-F TT turbine with extraction at 165 psia and 65 psia.

For example, with a throttle flow of 140,000 lb per hr the enthalpy at the first bleed point is 1266 Btu per lb of steam. Rankine-cycle efficiency in this section is about 70 per cent.

With a throttle flow of 140,000 lb per hr and 60,000 lb per hr extracted at 165 psia, the enthalpy at the second extraction point is 1205 Btu per lb—a Rankine-cycle efficiency of 80 per cent in the second section.

For lighter loads and lower steam flows the Rankine-cycle efficiency is lower—about 60 per cent at 40 per cent load.

In general, the Rankine-cycle efficiency is lower at higher initial pressures and in smaller machines; conversely it is higher for lower initial pressures and for larger machines. Fig. 8 shows the general trend of the Rankine-cycle efficiency at pressures 600 psia and 200 psia and for turbines ranging from 2000 kw to 7000 kw. Thus it may be concluded that the Rankine-cycle efficiency is higher in the lower pressure stages of an extraction turbine, and that we may expect optimum efficiencies of about 80 per cent in the last section of a turbine.

Pursuing this, we can determine the condenser factor for our machine.

A Mollier chart, Fig. 9, shows the expansion of the steam in the various stages of a turbine. Using the

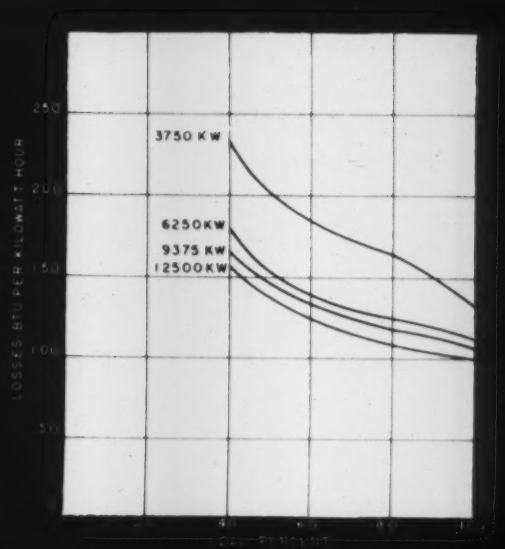

Fig. 5 Total losses in Btu per kwhr versus load

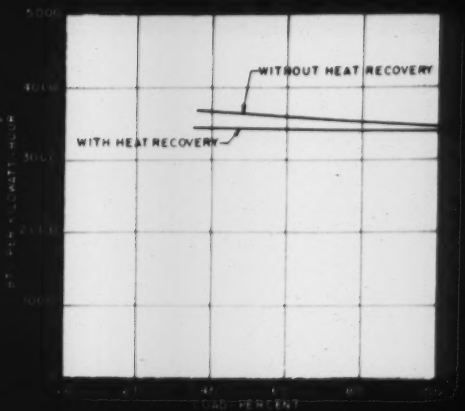

Fig. 6 Effect of the heat recovery on Btu per kwhr

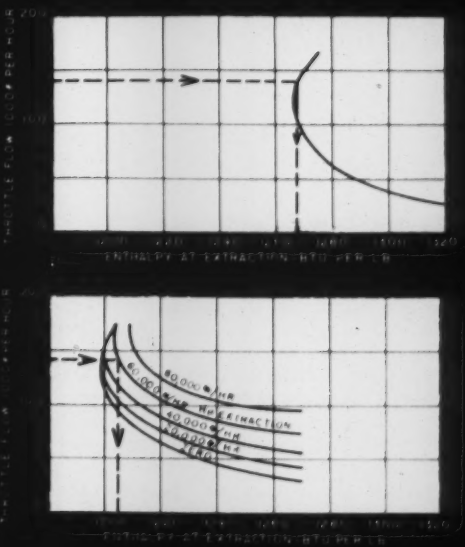

Fig. 7 Typical curve showing the enthalpy of the steam at the first and second extraction points of a double-extraction turbine versus steam flow in the several sections. *Top*, high-pressure extraction; *bottom*, low-pressure extraction.

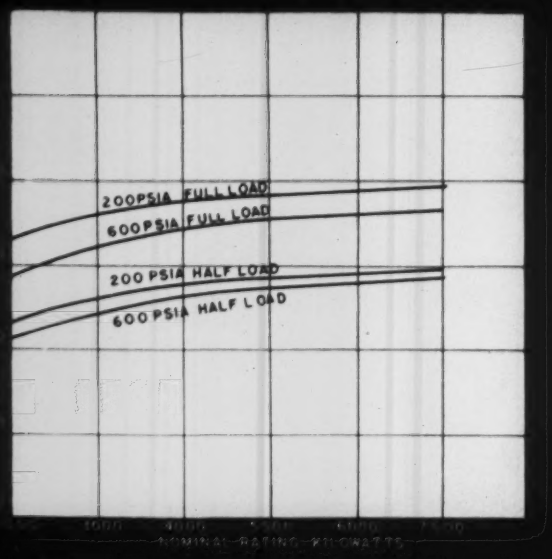

Fig. 8 Rankine-cycle efficiencies versus initial pressure and rating at 200 psia and 600 psia with full and half load

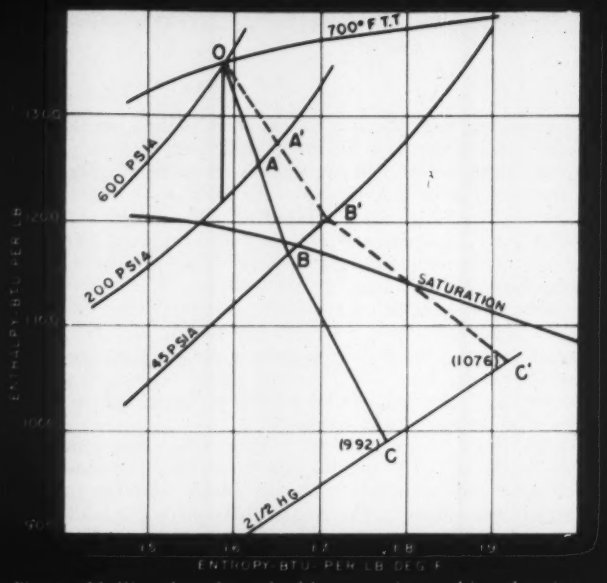

Fig. 9 Mollier chart for a double-extraction turbine showing the expansion of the steam in the various stages of a turbine

manufacturer's chart, Fig. 7, or the curve, Fig. 8, we may determine the Rankine-cycle efficiencies in the several stages and plot the expansion of the steam for several conditions of load.

For full load the steam expands along line OA in the first section, Rankine-cycle efficiency 70 per cent; in the second section the steam expands along line AB, Rankine-cycle efficiency 80 per cent. Assuming an efficiency of 80 per cent from the second extraction point to the condenser, expansion will be along line BC to $2^1/_2$ in. absolute. Enthalpy at this point is 992 Btu per lb. The heat of the liquid at $2^1/_2$ in. absolute is 76 Btu per lb. Therefore our condenser factor K_2 for this condition is 992 minus 76 or 916 Btu per lb. This is the latent heat rejected to the cooling water.

For a light load, say 40 per cent, the expansion will follow the dotted lines OA′, A′B′, and B′C′ to an enthalpy of 1076 Btu per lb entering the condenser. Heat of the liquid is again 76 Btu per lb. The condenser factor for this condition is 1076 minus 76 or 1000 Btu per lb. This again is the latent heat rejected to the cooling water.

Usually, the condenser factor K_2 will fall between the limits of 910 Btu per lb and 1000 Btu per lb, varying with load. Knowing the general load conditions this figure may be determined within accuracy limits of the meters.

Computations and Conclusions

The heat chargeable to power generation in an industrial plant may be determined from two readings, the kwhr generated, and the steam flow to the condensers.

The kilowatthour factor is K_1. Without heat recovery from the oil and air coolers, K_1 varies from 3700 Btu per kwhr at light load to about 3500 Btu per kwhr at full load. With heat recovery, 3450 may be used.

The so-called condenser factor K_2 varies from 910 Btu per lb of condensate at full load to about 1000 Btu at real light load. An average figure of 950 Btu per lb is probably within the accuracy required. Knowing specific load and extraction conditions this factor may be determined more accurately. Then we apply the formula

Btu for power generation = kwhr $\times$ K_1 + condensate wasted $\times$ K_2

In a plant with only back-pressure turbines and where all exhaust steam is used for process, and in a plant where all heat is recovered in the main condensers, we do not need to consider the second term of the formula. Hence:

1 Provided that the initial steam pressure is selected to allow proper utilization of process heat, the heat consumption of an industrial steam turbine is otherwise independent of the initial steam conditions and exhaust pressure. In other words, if we are using all exhaust steam from a back-pressure turbine for process, then the heat consumption is the same whether we operate between 1500 psig and 5 psig, or between 250 psig and 50 psig.

2 Under the same conditions, the Rankine-cycle efficiency of an industrial steam turbine is relatively unimportant. Where the ratio of process-steam requirements to electric power demand is high, low Rankine-cycle efficiency may, in some instances, be an advantage. Elimination of moisture from the process steam and from the last stages of a turbine will reduce erosion and lower maintenance.

3 It is only necessary to know the kwhr generated and the flow to the condenser, in order to determine the heat chargeable to power generation. From these figures, and knowing the conditions in the plant, we apply the following formula

$$\text{Btu} = PK_1 + WK_2$$

where

P = kwhr generated

W = flow to condenser in lb when heat is wasted

K_1 = with recovery of heat for process from the oil cooler and air cooler = 3450 Btu/kwhr

K_1 = without heat recovery = 3700 at light loads, 3500 at full load

Average figure of 3600 may be used

K_2 = (this factor is used only when heat in the condenser is wasted) = 1000 at light loads, 910 at full load

Average figure of 950 may be used

RESEARCH MANAGEMENT

How is the Research Dollar Spent?

By Blaine B. Wescott[1]
Mem. ASME

In the research laboratories of more than 15,500 companies, the comparatively young industry called Industrial Research employs over 160,000 scientists and engineers and at least 300,000 supporting personnel. In all, some 460,000 persons are engaged in this essential technological effort to keep the United States prosperous, progressive, and safe.

From 1920, when American business spent less than $50 million on research, the cost rose to more than $3.7 billion in 1953, as reported by the National Science Foundation, and increased to $4 billion in 1954. Expenditures for research and development, estimated at nearly $7 billion for 1957, will amount to about 1.5 per cent of the value of the gross national product.

The Driving Motivation

The most compelling reason for this expenditure is competition—competition to get a larger share of today's business, and a still larger share of future markets. Another important incentive is to effect greater diversification in a company's business. There is also research aimed at the development of products that will be needed some years hence by industries now in the making.

Constant improvement of product quality and performance is still another motive for large research expenditures, since a reputation for quality leadership is an important asset to any company. To bring about increased efficiency and economy in manufacturing operations, many companies authorize sizable research expenditures. Finally, many companies, particularly the larger ones, support basic research in their own laboratories and in laboratories of outside institutions, in the sciences closest to their interests.

It is essential for the research department to have a crystal-clear understanding of both the immediate and the long-range plans and objectives of the company, which is possible only if the research director is recognized as a full member of the management team.

There must be communication, which means an unimpeded two-way flow of information from operations to research about their current and future goals and their current and anticipated problems, while research must keep operations informed about the progress being made on both short and long-range projects.

The research manager should not expect communication to supply him with a ready-made research program. It will call attention to immediate problems, mostly developmental rather than research, but the research department must assume the responsibility for the generation of the long-range research program. That is its primary assignment from management.

A company's allotment of funds depends on numerous variables: The amount of money available; the nature of its business; the strength of its competition; its plans for the future; the attitude of its management toward research; the ratio of spending in company laboratories to that in outside laboratories; the relative amounts allotted to short and long-range projects; the proportions of the budget to be used for development projects, research projects, and basic research.

Outside Research

Any company that is not prepared to support a reasonable research program on a continuous basis should not have its own research department. Its sporadic research needs can be satisfied best by contracting for specific projects with outside organizations of established competence in the field of science involved.

Outside research organizations, whether or not they are operated for profit, can often be used advantageously by a well-established research department to supplement its own research program, to avoid the necessity of assembling a team of specialists for a project foreign to the normal scope of the department's interests, or for basic research.

For many years Gulf has sponsored basic research in an outside institution, where it is not subjected to the distracting pressures characteristic of industrial research laboratories. Expenditures for this purpose amount to

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Based on a paper contributed by the Management Division and presented at the Engineering and Management Conference, Pittsburgh, Pa., March 27–28, 1957, of The American Society of Mechanical Engineers.

The growth in our technology has created a new profession—research management. Industrial research has grown from its modest beginings after the World War I to a gigantic business, the foundation of our economic progress. Once an expensive luxury, it is now a necessity for every company looking to its continuing prosperity. The Research Department has been called the "department in charge of the future," and successful research organizations operate on the same principles as those of any other branch of business, in creating the ideas which are the goods they produce for their manufacturing departments.

about five per cent of our research budget. Depending on how the controversial term "basic research" is defined, from two to three times this percentage is allotted to basic research in our own laboratories. The portion of the research budget devoted to basic research by the larger industrial research organizations is usually quoted as ten per cent. However, there is nothing magic about this figure which actually varies from nothing for many small laboratories to considerably higher percentages for some of the largest.

Several factors enter into the optimum allocation of funds between short and long-range projects. In general, it appears logical that the percentage of the total funds budgeted for long-range projects should be proportional to the magnitude of the research program. Larger companies can justify sizable research expenditures today with the expectation of increased profits five or ten years hence. Whether or not this expectation is realized will depend to a large extent upon the ability of the research department to anticipate the future trends in technology, to foresee what the company will need, and to plan accordingly.

Proper timing is more important for long-range projects than for any other part of the research program. Commercialization based on long-range research usually entails extensive capital investments, and there is no profit in having such developments delayed for years due to lack of money or, on the other hand, to attempt to capitalize on developments prematurely. There must, of course, be some lead time between research and commercialization, and the most successful companies are those which have some latitude in choice of which research to capitalize upon.

Another problem involves the relative apportionment among the fields of activity of the several operating departments of the company. It is always a temptation to follow the path of least resistance and to tailor the program according to the pressure from each operating department; but this may not be best for the company. There is also the question of how much technical service the research department should provide.

Four factors enter the calculation at Gulf. First, we are fortunate in that we can and do use every means of two-way communication to help formulate the research program and to help translate research results into commercial operations. Second, the principal operating departments for which we do petroleum research are: exploration and production, transportation, manufacturing, petrochemicals, and sales. Third, our research projects may originate from any department or individual. A large number of short-range and developmental projects originate from the operating departments, while essentially all of the long-range and basic research projects are generated within the research department. Fourth, since the research company is a wholly owned, nonprofit subsidiary of the parent corporation, the research costs are charged as expense against the respective operating departments.

One Company's Method

A brief description of our program-formulation and budget procedure may help in answering some of the complex questions associated with research management. The over-all budget is the sum of the budgets for individual major projects and subprojects, which are prepared by the research department in the usual manner. However, the project budgets are assembled into five groups corresponding to the operating departments mentioned previously which are charged with the research costs. Then, by means of a conference with the management of each operating department, it is determined which projects each particular department will support. The department is supplied in advance of the conference with a brief report summarizing the objectives of the project, the progress made during the past year, the program for the next year, and the estimated costs. The projects include developmental research, short and long-range research, basic research, and technical service.

When these conferences with the five operating departments are completed, approval has been obtained for the five budgets, the sum of which is usually a high percentage of the total budget prepared by the research department. The remaining portion of the budget is then reviewed by research management, and a decision made as to how much of this program should be included in its own budget for which it is directly responsible to top management of the parent corporation. The resulting over-all budget is then presented to the corporation's budget committee for approval. The research department's own budget provides the essential insurance against appreciable fluctuations in the magnitude of the research program, and is conducive to cordial relations between the research and operating departments. Our experience with this procedure has been highly satisfactory, and it is of particular interest that the operating departments have not been reluctant to support either basic or long-range research in fields of the company's normal interests.

Distribution of Effort

Now, a brief look at the distribution of research effort among the five main activities of our parent corporation. Approximately 25 per cent of the budget is allotted to research on problems concerned with the discovery and production of petroleum. Research on the improvement of refining processes and the development of new processes accounts for about 34 per cent. Approximately 29 per cent of research expenditures goes for improvement of product quality and development of new products. Petrochemicals process and product research requires about nine per cent of the budget. Research on problems connected with transportation of crude oil and refined products by pipeline, tank cars, barges, and tankers amounts to only about one per cent. Miscellaneous expenditures make up the remainder. It should be mentioned that, by our method of research cost accounting, certain types of engineering development, which only the research department has the facilities to perform, are classed as technical service. This, together with special technical services which can be handled best by the research department, comprises about 20 per cent of the total costs. This amount is included in the categories mentioned previously.

Data available indicate that the research departments of other oil companies of comparable size and interests have patterns for spending their research dollars which vary widely from ours. They also vary just as widely from each other. Like all new professions, research management is plagued with growing pains and confronted with problems for which there is no history of experience to help provide the best answers. There is no substitute for sound judgment.

CONTROL PROBLEMS

. . . in Sodium-Cooled Graphite-Moderated Reactors

By J. E. Owens

Atomics International, Canoga Park, Calif.

CONTROL and instrument systems must still be tailored to each reactor despite the fact that the nuclear instrumentation is now considered "conventional" and can be purchased in standard units. The principal problems remaining for the instrumentation and control business are those incurred in matching the performance of each reactor to its own particular purpose.

The problems in the Sodium Reactor Experiment,[1] Fig. 1, arise because sodium-coolant flow must be coordinated with the reactivity level to prevent overcool-

[1] The Sodium Reactor Experiment constructed by the Atomics International Division of North American Aviation Inc., developed for the Atomic Energy Commission, is located in the Santa Susana Mountains, about 25 miles NW of downtown Los Angeles, Calif. Designed to demonstrate the feasibility of the sodium-cooled graphite-moderated reactor concept, Southern California Edison Company has recently been authorized to buy the heat for power generation that was previously dissipated in airblast heat exchangers.

The SRE is a 21-thermal megawatt graphite-moderated-sodium-cooled slightly enriched-uranium fueled plant, with a 6-ft-high × 6-ft-diam core. The stainless-steel-clad fuel elements are spaced in an 11-in. triangular lattice. Other parameters are 750-F average and 1200-F max fuel temperatures with 500-F coolant-inlet and 960-F coolant-outlet temperatures; 485,000-lb-per-hr (1180-gpm) main-system flow rate and 24,250-lb-per-hr auxiliary-system flow rate.

Contributed by the Nuclear Engineering Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS and presented at the 1957 Nuclear Congress, Philadelphia, Pa., March 11-15, 1957. Condensed from Paper No. 57—NESC-77.

ing of the reactor, and consequent damage from "cold" transients in addition to high-temperature transients.

To understand the interrelationship of all of these problems, it is first necessary to know something of the instrumentation pattern that has been developed. Eight thermal-neutron detectors located in the thimbles at the periphery of the outer tank provide neutron-flux-level signals for controlling the reactor. Two fission chambers provide neutron-level signals to duplicate counter channels used during the startup operation. Two compensated ionization chambers provide neutron-level signals for duplicate log-N and period channels. Two fission chambers provide signals to duplicate high-neutron-level safety channels. One compensated ionization chamber provides a neutron-level signal to the automatic-control system, and the remaining compensated ionization chamber provides a neutron-level signal to the neutron-flux-level channel. The six ionization chambers remain fully inserted in the thimbles during high-power operation. The two counter channels are used primarily for start-up operation and their fission chambers are retracted by motors as the reactor power increases.

Each of the two counter channels, Fig. 2, contains a fission chamber, a preamplifier, a high-gain linear amplifier, a log-count rate meter, and a low-level period amplifier. The two channels have a common log-count rate recorder with a switch to permit the recording of either channel.

Each start-up fission chamber rides in a four-wheeled cart which is raised and lowered in the thimble by a motor. The motor is controlled by a switch on the reactor control console. A synchro position indicator on the control console follows a transmitter which is also driven by the motor. A light on the main control console indicates when the fission chamber is completely inserted. Limit switches shut off the motor drive when the chamber is at the limit of its travel in either direction.

Each of the two period channels contains a gamma-compensated ionization chamber, a chamber power supply, a log-N amplifier, and a high-level period amplifier. The two channels have a common log-neutron-flux recorder, with a selector switch to permit recording either channel, and a period recorder with a four-position selector switch for recording the output of either of the four period amplifiers (two low-level and two high-level period channels). The period amplifiers will initiate a scram if the reactor period becomes shorter than a pre-set value. The period amplifiers supply scram signals directly to the safety amplifier.

The two safety channels, Fig. 3, are comprised of two fission chambers and a two-channel safety amplifier. The two channels have a common two-pen recorder. Note that fission chambers are used as current chambers in the neutron-level safety channels.

The neutron-level control channel consists of a compensated ionization chamber, a chamber voltage supply, a continuous-balance potentiometer, and a position-adjusting-type controller.

The output of the ionization chamber provides a neutron-level signal to the controller. The output of the controller operates two relays controlling a two-phase motor which drives the regulating rod. If the level signal differs from the operating-level set point, an error signal is produced, and the regulating rod is driven to re-establish a balance. The controller has adjustable rate action to prevent overshoot or oscillation of the regulating rod, and reset action to prevent the neutron flux from settling off the control point.

Table 1 SRE Trouble Interlocks

		Corrective Actions		
Trouble	Alarm	Motorized rod insertion	One rod drop & motorized rod insertion	Full scram
1 Short period during startup (from log N circuits)	X	X	...	X
2 High neutron flux	X	X	...	X
3 High temperature in fuel-outlet channels	X	X	X	X
4 Manual	...	X	...	X
5 Low - flow main sodium systems	X	...	X	...
6 Loss air-blast fans	...	...	X	...
7 Loss of commercial power	...	...	X	...
8 Earthquake	...	...	X	...
9 Loss of boiler feedwater	...	...	X	...
10 High - temp exit intermediate heat exchanger	...	...	X	...
11 High - temp exit air-blast heat exchanger	...	...	X	...

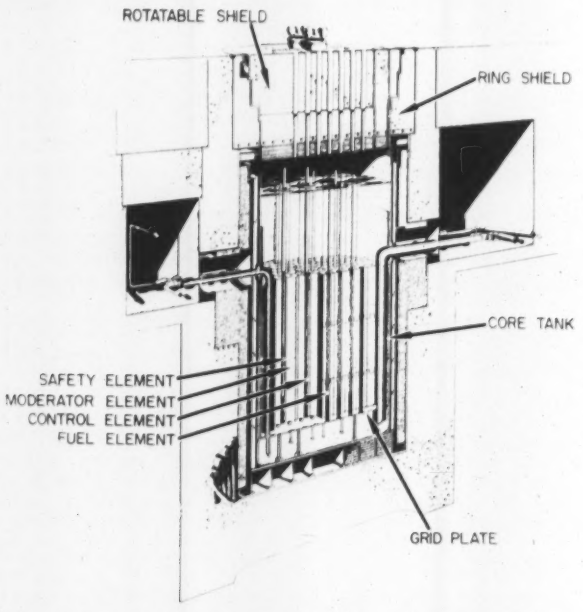


Fig. 1 Cross section of Sodium Graphite Reactor Experiment core

The controller is flexible and can be connected to receive other signals, e.g., sodium temperature or steam pressure. Experiments with the SRE will determine the optimum type control for this type reactor.

The neutron-flux-level channel contains a compensated ionization chamber, a chamber voltage supply, a vibrating-reed electrometer, and a flux-level recorder.

Safety Problems

The primary control problems associated with sodium-cooled graphite-moderated reactors are thermal problems. The reactor control system must prevent large positive-temperature excursions. On the other hand, negative-temperature excursions of too great a magnitude may also be damaging. Fig. 4 shows the power and flow transients following a simultaneous safety-rod scram and sodium-pump shutoff. Since the power-generation rate decays much more rapidly than the power-removal rate, care must be taken to avoid a "cold" transient with possible damage to massive components such as the core tank.

Extensive computer studies were made in an effort to anticipate these problems and to find solutions for them. A shutdown effected by dropping one safety rod, worth approximately 2.5 per cent in reactivity, will cause a minimum-temperature transient. As a result, the safety circuits were revised to drop only one safety rod for all anticipatory troubles. The one-rod scram circuits are carefully interlocked. If the selected rod fails to drop, a full four-rod scram is initiated. All scrams are followed by motorized insertion of all eight control-rod mechanisms.

Efforts have been made to insure that only serious troubles will initiate reactor scrams. Table 1 lists abnormal operating conditions and the corrective actions taken. Of course, this is not a complete list of plant alarms, only those requiring immediate, automatic, corrective action. Note that all one-rod scram conditions are either loss-of-coolant or anticipatory loss-of-coolant conditions. Setback is accomplished by motor driving the four shim rods in until the setback condition is cleared. All corrective actions are accompanied by appropriate audible and visual alarms to inform the operator of what type trouble has occurred.

Power Control

The SRE is designed to operate at fixed inlet and outlet temperatures. The airblast heat-exchanger fans are automatically controlled to hold the exit sodium-temperature constant. Similarly, the steam-generator feedwater flow is automatically controlled to hold the exit sodium-temperature constant. Steam pressure is controlled by varying the turbine-throttle opening. If a sodium-graphite reactor could operate always at steady-state full power, there would be few control problems. However, power plants must follow load demands, even base-load plants must be able to adjust to system conditions. Some of the complications are shown in Fig. 5. Since reactor temperatures must be held constant, load changing must be accomplished by varying sodium flow. In the sodium-flow control system for the SRE, the primary and secondary-flow rates may be varied independently, or the secondary-flow rate may be "slaved" to the primary through an adjustable-ratio control. Sodium-flow rates in the SRE are manually set to desired values and held by the pump-control circuits. In the

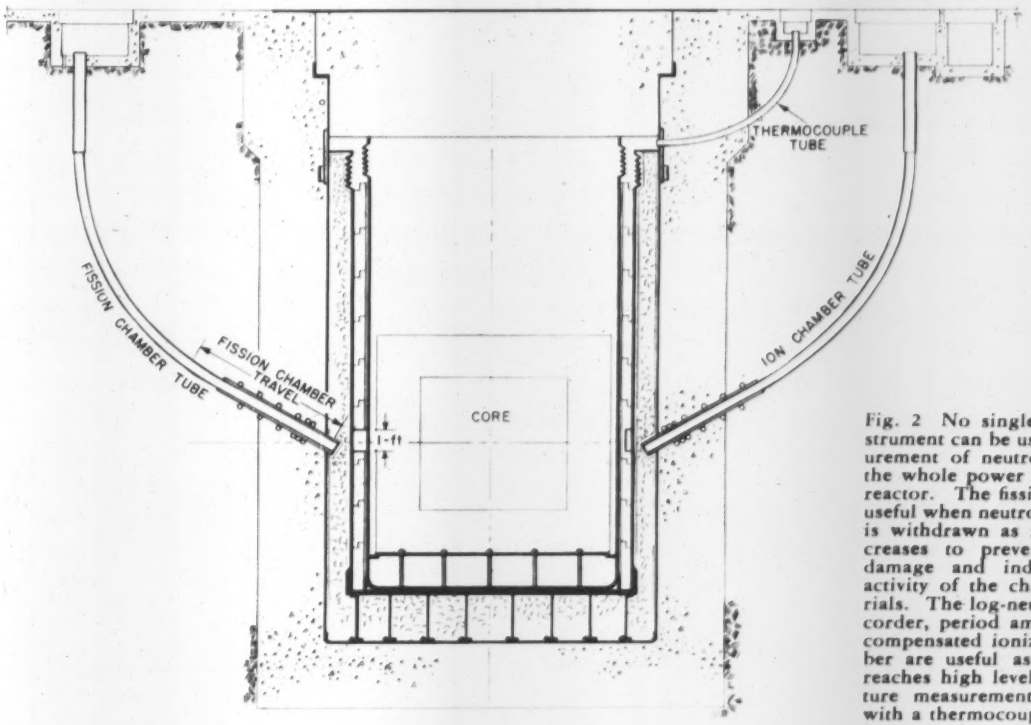


Fig. 2 No single type of instrument can be used for measurement of neutron flux over the whole power range of the reactor. The fission chamber, useful when neutron flux is low, is withdrawn as reactivity increases to prevent radiation damage and induced radioactivity of the chamber materials. The log-neutron-flux recorder, period amplifiers, and compensated ionization chamber are useful as the reactor reaches high level. Temperature measurements are made with a thermocouple.

future, automatic-flow controls will be added to facilitate experiments to determine the characteristics of the SRE when operated as a load-following plant.

Steam-Pressure Control

As power level in the plant decreases, the temperature drive across the intermediate heat exchanger will decrease. If sodium-flow rates are held at a one-to-one ratio, the drive across the heat exchanger is directly proportional to power. This means that at low power levels the secondary-system temperatures increase and with lower steam flows this would normally result in much higher steam pressures.

The situation in the SRE is more favorable since the steam generator is a once-through type and steam pressure can be controlled by varying the feed-water flow. Note the relation $Q = UA\Delta T$ where Q is heat transferred, U is an over-all heat-transfer coefficient, A is surface area, and ΔT is temperature difference. The once-through boiler allows indirect control of A.

Fig. 6 shows the expected sodium-flow rates and temperatures in the SRE. Note that the flow ratio is varied.

Methods under consideration for holding constant steam pressure at all loads in a large sodium-graphite reactor plant include:

1 ***Unbalancing secondary and primary-flow rates.*** This has been the favorite proposal since it involves no extra hardware and therefore can be implemented at low cost. By operating the secondary sodium system at a lower flow rate than the primary, the *average* secondary temperature can be lowered even though the primary sodium temperatures remain constant. However, recent analysis indicates that previous estimates may have been unduly optimistic. Also, this may result in sodium temperatures at the boiler exit which approach the freezing temperature of sodium, 208 F. It may also be difficult to obtain the precise flow control required since steam pressure becomes a sensitive function of sodium flow.

2 ***Sodium bypass valve around the boiler.*** A control valve to shunt part of the sodium flow past the boiler will allow lower average sodium temperature in the boiler without lowering the average temperature of the entire secondary sodium loop. Troubles are expected in obtaining a reliable control valve, with thermal stresses incurred in mixing hot bypass sodium with cold sodium from the boiler, and with the low-temperature sodium at the boiler exit.

3 ***A steam-dump valve.*** The boiler can be operated at rated capacity and excess steam dumped directly to the condenser. This is a promising method for overriding short-load losses but is prohibitively inefficient for use in normal control.

4 ***Feedwater bypass valve around the feedwater preheater.*** A control valve to shunt feedwater around the preheater will lower steam pressure by injecting cold water into the evaporator.

5 ***Steam throttle valve.*** A pressure-dropping control valve between the boiler and the turbine will enable the turbine to be operated at constant pressure, however,

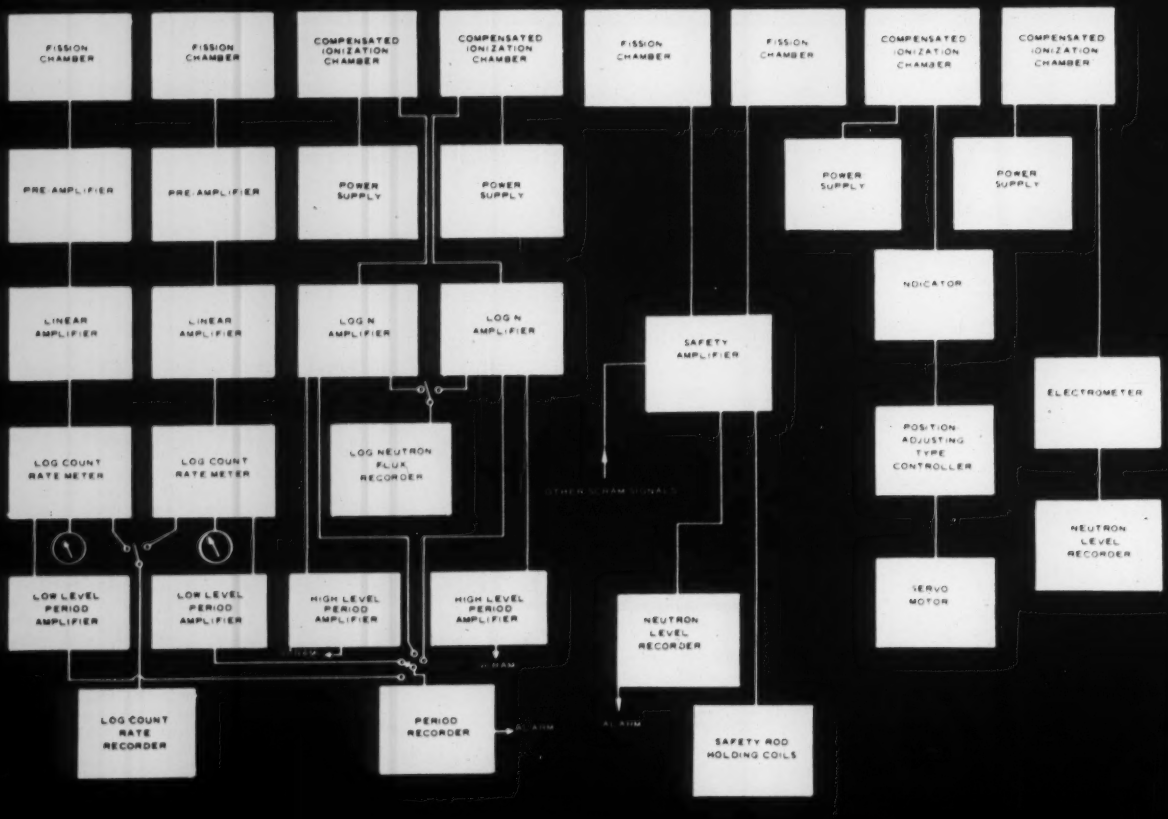


Fig. 3 Diagram of the nuclear instrumentation for all eight channels

the boiler must be designed for maximum attained pressure.

6 Once-through boiler. Steam pressure in a once-through boiler is effectively controlled by varying the feedwater flow and thus the water-steam interface. In the SRE boiler, at 100-per-cent load, approximately 50 per cent of the boiler is superheater, at 20-per-cent load nearly 90 per cent of the boiler is superheater. This type operation places considerable stress on proper attemperation but the pressure regulation is simple. Once-through boilers are quite new in this country, but they hold considerable promise as experience is gained with them. The primary difficulty appears to lie in the extremely stringent feed-water purity requirements.

7 Vary reactor temperatures. Most reactor plants to date have attacked the steam-pressure control problem by programming reactor temperatures with load. The high thermal capacity of the sodium-graphite-reactor core and the large amount of stored heat in the sodium plenum preclude any rapid temperature changes. Also the high operating temperatures, the excellent heat-transfer properties of sodium, and the vulnerability of the massive stainless-steel components to thermal-shock damage combine to require extremely slow temperature variations. Thus the search for alternative methods of steam-pressure control.

It is not certain which method of steam-pressure control will prove most effective. Probably a combination of several methods. The feedwater bypass valve looks very promising. Steam-dump valves will be used for short-time control during loss-of-load transients. Perhaps long-time load changes can best be made by resetting reactor temperatures.

Conclusion

Since boilers and heat exchangers do not lend themselves to easy analysis, an extensive, experimental program will be required to check the validity of the assumptions used in calculating the information given here. Data from the SRE will be combined with a comprehensive analysis effort to determine optimum operating techniques for the SRE. Future sodium-graphite reactor designs will incorporate the knowledge gained from the SRE.

The earliest series of tests with the SRE will give information on sodium-flow transients and on the temperature transients associated with reactor power variations and with reactor scrams. These data will be compared with the data obtained from the analog simulator studies which have been made over the past two years. The comparison will enable the determination of the accuracy of the simulator and should allow the construction of more precise simulators for future reactors.

Acknowledgments The information presented here is largely from work done by the General Engineering Group at Atomics International. L. R. Blue and D. J. Cockeram are largely responsible for the simulator studies. W. T. Morgan, W. F. Banks, and E. B. Ash did most of the work on steam-pressure-control methods.

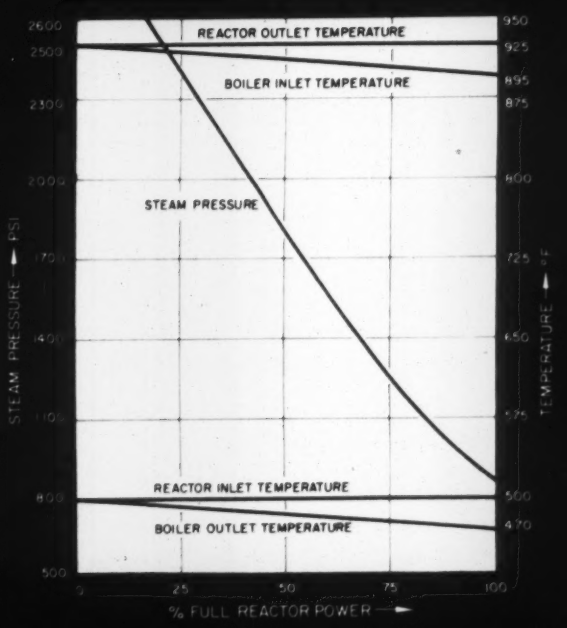


Fig. 5 With the use of reactor heat for power generation, additional complications were added to the SRE control problem. Sodium temperature and steam pressure versus load are shown.

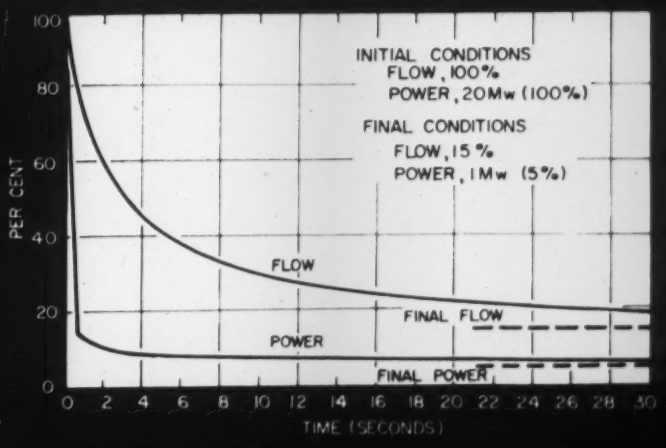


Fig. 4 Power and flow-decay curves demonstrate the drop that takes place in a scram shutdown

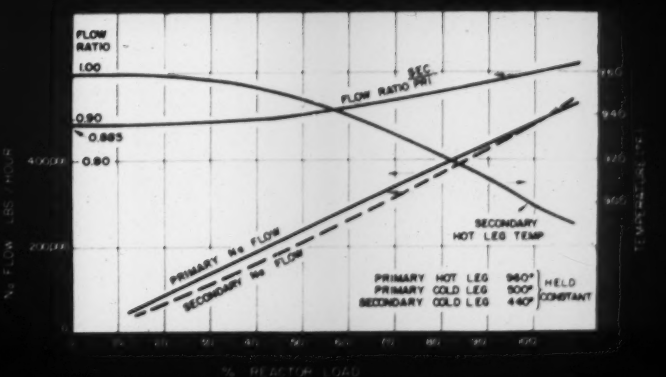


Fig. 6 The relationship of reactor load to sodium flows and temperatures for the SRE

Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Editor*

Tri-Dam Project Dedicated

California's Tri-Dam Project, a joint venture of the Oakdale Irrigation District and the South San Joaquin Irrigation District, was formally dedicated June 15. The dedication took place at the Beardsley Dam, about 150 miles east of San Francisco, Calif.

Three new dams—the Donnells, Beardsley, and Tulloch—will increase water storage on the Middle Fork of the Stanislaus River by 230,400 acre-ft and provide 81,000 kw of electric power contracted for by the Pacific Gas and Electric Company. The power agreement made it possible for the irrigation districts to obtain financing readily.

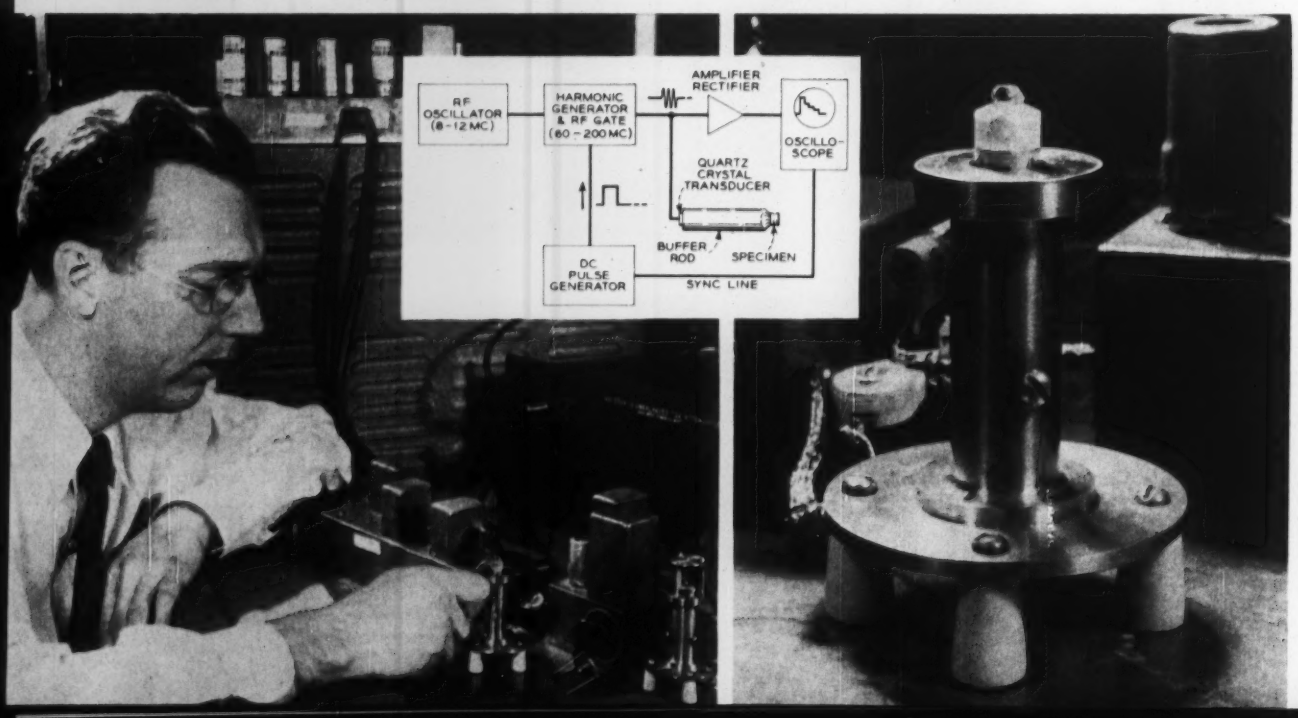
The Donnells powerhouse is equipped with the largest vertical-impulse-type hydraulic turbine in the United States. This Allis-Chalmers six-jet turbine develops 74,500 hp under 1151-ft head and is direct connected to a 67,500-kva, 80 per cent pf, 13,800-volt Allis-Chalmers generator operating at 240 rpm to produce 54,000 kw of electricity.

The three-mile-long reservoir at Donnells, the greatest hydroelectric power producer of the three dams, will store 64,500 acre ft of water.

Control center for the three dams is the centrally located Beardsley powerhouse equipped with an Allis-Chalmers 14,000-hp Francis-type hydraulic turbine operating under 258-ft head direct connected to an 11,100-kva, 9990-kw, 9 per cent pf, 6900-volt generator operating at 300 rpm. The governor, butterfly valve, switch-gear, and transformer are all of Allis-Chalmers design.

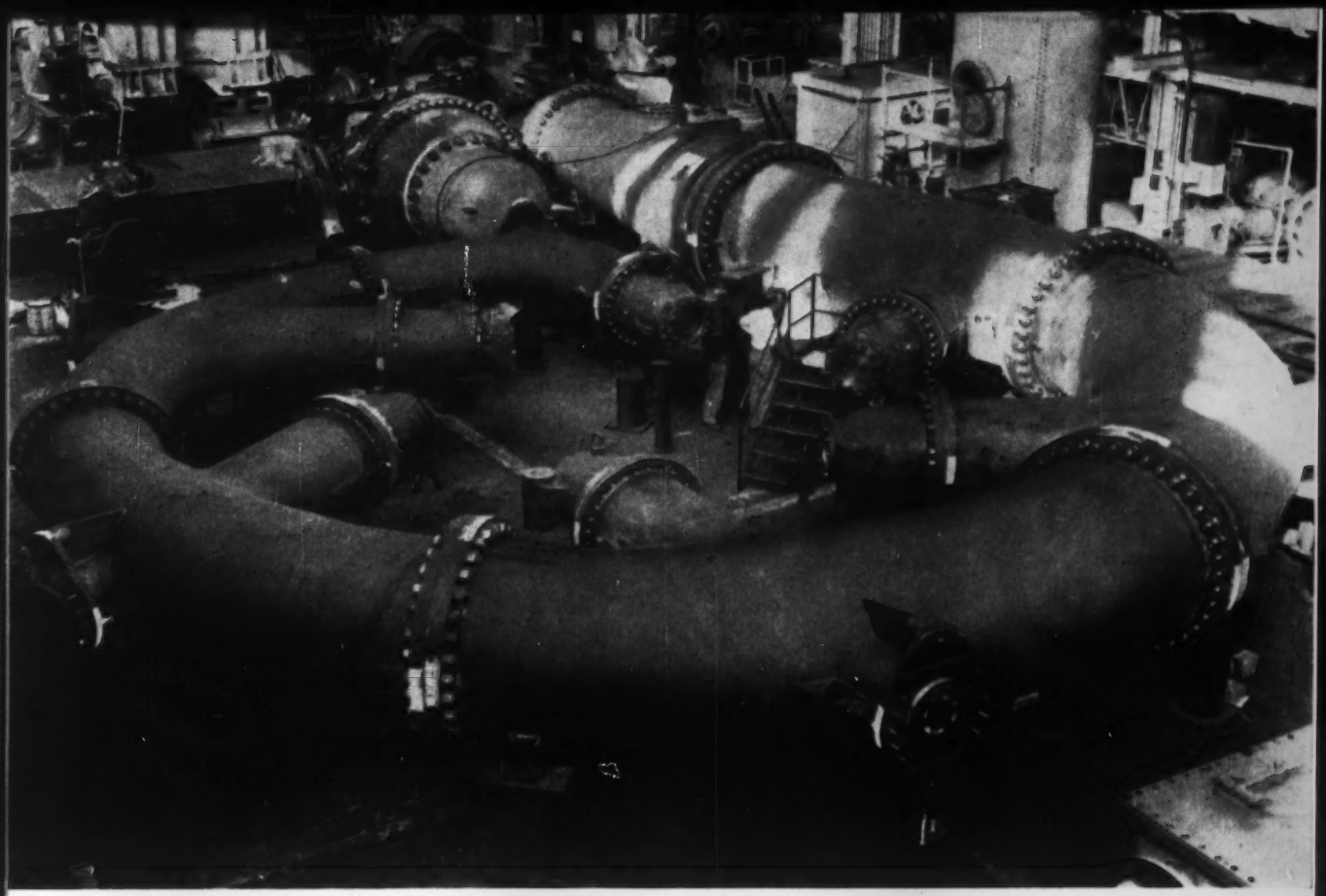
The Tulloch Dam, 45 miles downstream from Beardsley is still under construction. Its power-generating equipment, furnished by S. Morgan Smith, and Westinghouse, will consist of two 12,000-hp, 153-ft-head Francis-type hydraulic turbines direct connected to 240-rpm generators to provide 17,000 kw.

Engineering design for the Donnells powerhouse, Beardsley dam and powerhouse, and Tulloch dam and powerhouse was handled by the International Engineering Company. Engineering design for Donnells dam and Tulloch afterbay was handled by George E. Goodall Company. Tudor-Goodenough Engineers co-ordinated and supervised all engineering. Construction work for Donnells and Beardsley units of the project was handled by Tri-Dam Constructors, comprised of Morrison-Knudsen Company, Inc., Peter Kiewit Sons Company, Stolte, Inc., and Macco Corporation. Construction for the Tulloch units was handled as a joint venture by The Arundel Corporation and L. E. Dixon Company.



Block diagram, *center*, of the ultrasonic technique developed at Bell Telephone Laboratories for determining the elastic moduli of small specimens. Placing a diamond on the "buffer" rod for testing, *below*.

Close-up of the fused silica "buffer" rod and assembly used in determining elastic modul. A diamond can be seen in place at the top end of the rod. At the bottom end is a quartz transducer.



Nozzle pipe assembly of 74,500-hp, 1151-ft-head, 240 rpm vertical six-jet impulse turbine for the Donnells powerhouse being checked on the assembly floor of Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Elastic Moduli Measurement

An ultrasonic technique for accurately measuring the elastic moduli of small specimens of a wide variety of materials has been developed by Bell Telephone Laboratories. With suitable auxiliary equipment, the method can be applied to specimens under widely varying conditions of temperature and pressure.

The ultrasonic technique consists essentially of transmitting short trains of high-frequency mechanical waves into the specimen and determining their velocity of propagation.

From these data and also the known density of the specimen, the elastic moduli can be calculated. In the work with diamond, both longitudinal and shear waves were used, giving data for determining its three elastic moduli.

Flat and parallel surfaces were ground on opposite sides of the diamond, and its thickness measured very precisely. The specimen was then fastened to one end of a fused silica "buffer" rod by means of a thin film of viscous liquid. A suitable quartz transducer was attached to the opposite end of the buffer.

Repeated trains of ultrasonic waves at frequencies up to 200 megacycles, generated by the transducer, were transmitted along the buffer rod. These wave trains were principally transmitted into the specimen, and reflected back and forth between its parallel surfaces, resulting in a series of multiple reflections. At certain critical frequencies, these echoes were precisely in phase, and combined to give rise to a characteristic pattern on an oscilloscope responsive to the transducer. The velocity of propagation in the specimen could then be determined from these frequencies and the thickness, and, from a knowledge of the density, the adiabatic elastic constants were computed.

Two diamonds were used in these studies. Before cutting, each was a natural dodecahedron of a pale yellow color and quite transparent. Both were Type I diamonds as evidenced by a strong optical absorption at 8 microns wavelength, and each was a single crystal as determined by x-ray reflection patterns.

Expressed in units of 10^{12} dynes per sq cm, the elastic moduli were 10.76 ± 0.6 per cent for C_{11}; 1.25 ± 5.4 per cent for C_{12}; and 5.76 ± 0.3 per cent for C_{44}. While the value for C_{11} agrees reasonably well with previous measurements, the value for C_{12} is much smaller and that for C_{44} larger than other workers have reported.

Ultra-High-Strength Steel

THE National Bureau of Standards has experimentally produced an ultra-high-strength steel that can be heat-treated to a strength of 285,000 psi with sufficient ductility for structural applications. The steel is made by normal melting and working processes and should not be difficult to manufacture.

Because of the urgent need for stronger steels and reduced weight for landing gear on aircraft, the Navy Bureau of Aeronautics has sponsored research to develop a steel having a tensile strength of approximately 300,000 psi.

Although many steels can be heat-treated to strengths of 300,000 psi and higher, they are normally quite brittle at this strength level, precluding their use where ductility and toughness are required.

Preliminary considerations indicated that the strength level desired could not be obtained in structural steel containing less than about 0.40 per cent of carbon if the steel were to be given some form of tempering treatment subsequent to hardening. In addition, the steel would require considerable amounts of alloying elements in order to transform completely to martensite—the constituent of hardened steel—so that large components could be hardened throughout. The experimental steels were therefore based on AISI 4340 modified as desired. Boron was added to a split of each melt, since previous studies had indicated that boron increases hardenability and has a beneficial effect upon the impact properties of some steels at room temperature and below, although the present tests neither confirmed nor disproved the earlier studies.

Over 40 experimental steels were melted in the Bureau's foundry. These were forged and rolled into $^{5}/_{8}$ in., $^{7}/_{8}$ in., and $1^{1}/_{4}$ in. plates, which were then normalized and annealed. Tensile and impact specimens were heat-treated by six different methods, and tested.

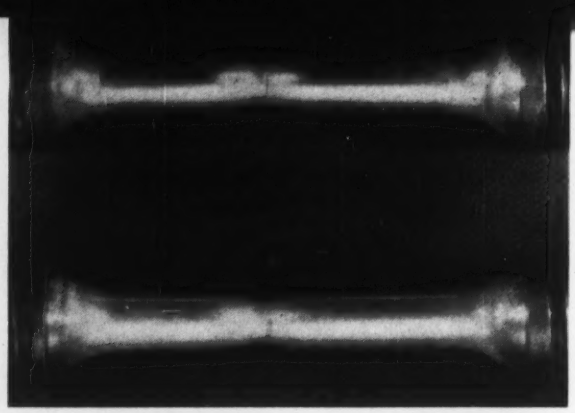
One particular composition, a steel based on AISI 4340 modified by the addition of silicon and titanium, possessed an ultimate tensile strength of approximately 285,000 psi, and an impact resistance of 16 ft-lb at both +70 F and −40 F. The composition and nominal mechanical properties of the steel are given in Tables 1 and 2. Even better ductility and toughness properties were obtained on a single heat that was vacuum remelted.

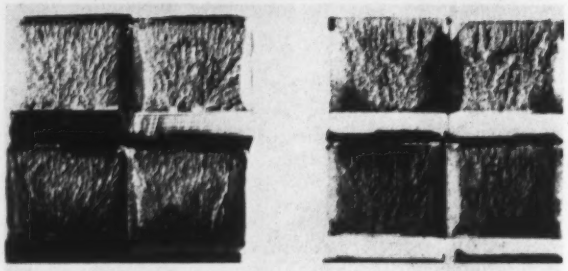
Table 1 Chemical Composition of the NBS Ultra-High-Strength Steels

	Per cent
Carbon	0.40
Manganese	0.75
Silicon	1.60
Nickel	1.80
Chromium	0.85
Molybdenum	0.30
Titanium	0.10
Boron	0.003

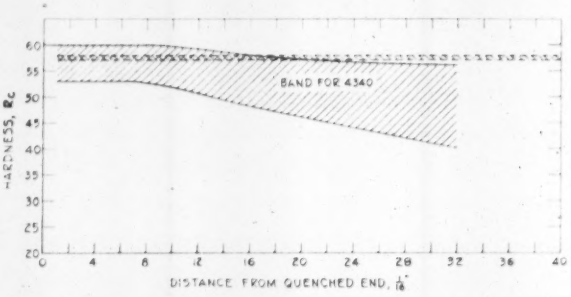
Table 2 Mechanical Properties of the NBS Ultra-High-Strength Steels

Hardness, Rockwell C scale	53
Ultimate tensile strength, psi	285,000
Yield strength, psi	235,000
Elongation, 1.4-in. gage length, per cent	10
Reduction in area, per cent	35
Charpy V-notch impact strength	
room temperature, ft-lb	16
−40 F, ft-lb	16





Specimens of NBS high-strength steel after test. The lip at the sides of the fractured surfaces of the Charpy V-notch specimens, *bottom,* and necking at the fracture of the tensile specimens, *top,* indicate the steel's high ductility.



End-quench hardenability band for two NBS steels superimposed on the band for AISI 4340 steel. The high level of hardenability of the NBS steels is indicated by the constant hardness from the quenched end, where the rate of cooling is extremely fast, to $2^{1}/_{2}$ in. from the quenched end, where the rate of cooling is quite slow.

Preliminary experiments were carried out to determine the critical temperatures—the temperature at which martensite forms—and the maximum time that the steels could be held above the critical temperature before transformation to other constituents occurred. Different hardening treatments using oil or air quenches were also studied. A conventional oil quench from 1650 F, followed by double tempering in the temperature range 400 to 500 F, produced the best all-around properties, so this heat-treatment was used for all subsequent tests.

Although boron apparently has no particularly beneficial effect on the properties of the steels, neither does it appear to have any detrimental effect. In steel structures appreciably larger in cross section than those tested, the beneficial effect of boron in improving hardenability may be advantageous. It is believed that the properties obtained on the laboratory steels can be duplicated or even improved in well-made commercial steels.

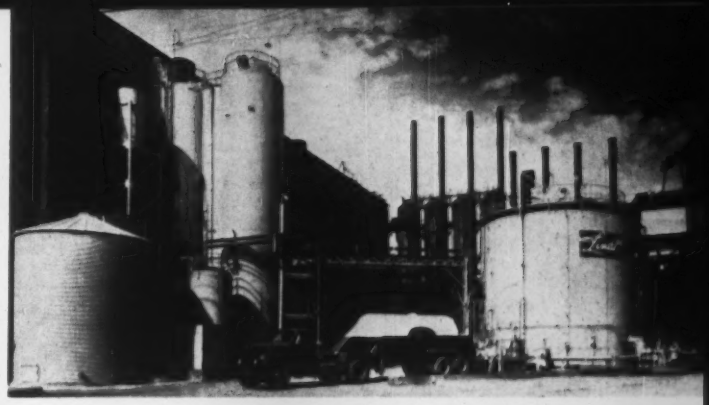
Oxygen-Enriched Blast

THE world's largest single-unit oxygen-producing plant for steel-mill service has commenced operation at the Duquesne, Pa., works of the United States Steel Corporation.

The oxygen is used for 6 per cent enrichment of the air blast to boost ferromanganese production by accelerating the smelting process. With additional oxygen entering the furnaces, the normal daily production of 700 tons of ferromanganese at Duquesne is expected to be increased by over 25 per cent. At the same time, coke consumption will be reduced.

The oxygen plant of over 500-tons-per-day capacity is a one-customer production unit built and operated by the Linde Company, a Division of Union Carbide Corporation. Linde has a number of one-customer units which are located on or close to the site of the user's own plant which range in capacity from 10 tons to thousands of tons per day. On-site production is supplemented during peak-demand periods, or during shutdowns, with liquid oxygen from a nationwide production and distribution system.

The Duquesne unit provides: (*a*) 430,000 cu ft per hr of 95 per cent pure—low purity—oxygen directly to two ferromanganese blast furnaces; (*b*) an initial delivery rate of 42,000 cu ft per hr of 99.5 per cent pure—high purity—oxygen for electric furnaces, scarfing machines, and other steel-mill operations; (*c*) liquid oxygen for stand-by storage.



Linde's plant on U. S. Steel property at Duquesne, Pa., produces over 500 tons per day of oxygen for mill use. Low-purity oxygen is used in the ferromanganese blast furnaces; high-purity oxygen in electric furnaces, scarfing, and other mill operations. The 10,000,000-cu-ft storage tank, and a part of the interchanger are shown. Compression, purification, and other equipment are housed in the building at left.

Cast Stainless Pumps

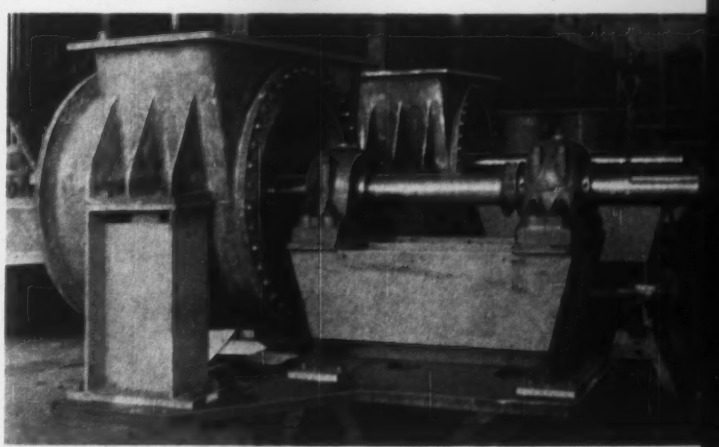
NINE years of continous exposure to one of the most corrosive environments known to the chemical industry—a solution of calcium and magnesium chlorides with solid NaCl in suspension having a pH of 6 at 220 F—has left no sign of corrosion on two cast stainless screw pumps used to circulate the "mother liquor" in a large evaporator. According to engineers of the Westvaco Chlor-Alkali Division, Food Machinery & Chemical Corporation, South Charleston, W. Va., the large screw pumps, made from molybdenum-containing cast-stainless alloy type CF-7M circulate a solution of sodium chloride having a 1.41 sp gr, and containing significant amounts of calcium and magnesium chlorides, with 8 to 10 per cent sodium-chloride crystals in suspension.

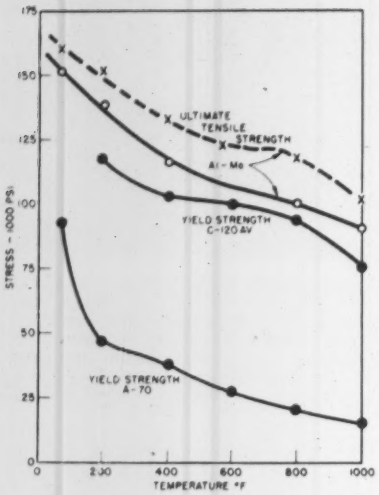
In a smaller evaporator used previously, copper and bronze pump parts failed in 15 months; cast-iron parts lasted about three years; and parts made of CF-7 cast alloy (equivalent to type 304 wrought stainless) were good for only four to five years. To eliminate the expensive replacement of pump parts, Westvaco engineers put the problem in the hands of the Zaremba Company, Buffalo, N. Y., which designed and built a new 180-in-diam multicirculation double-effect evaporator. Working cooperatively with the design department of a recognized high-alloy foundry, Zaremba engineers designed the special screw-type pumps employing ACI type CF-7M alloy (same nominal composition as wrought type 316—19 Cr, 9 Ni, 2.5 Mo, 0.07 max C) castings as specified by Westvaco engineers, to handle 20,000 gpm at 8 ft total dynamic head.

To insure that the pumps would withstand the extremely severe corrosive environment, Westvaco engineers specified that the pump castings be of x-ray quality at all critical sections and receive a solution heat-treatment, consisting of holding the castings at 2050 F to 2100 F for approximately 1 hr, and then quenching in water. This has the effect of putting carbon in solution, so that there are no precipitated chromium-carbide areas to act as focal points for intergranular corrosion.

Westvaco engineers report that substantial savings in replacement and maintenance cost have been obtained as a result of the increased life of the CF-7M castings. They point out that the present life of the equipment is already more than double that of the best previously used material—at an increase in first cost of less than 10 per cent. The corrosion resistance of the alloy as well as the quality of the castings is corroborated by the appearance of the pumps which look as good as new.

Specially designed from type CF-7M stainless alloy, large-pump castings are being prepared for boring of 36-in. ID discharge ends of pumps. The rectangular suction flange above the back head of each pump is 20 to 54-in. ID in this Kutztown Foundry & Machine Corporation photo.





Typical elevated temperature strength of Rem-Cru C-130AMo titanium alloy, based on preliminary data. The alloy has a nominal composition of 6 1/2 per cent aluminum and 3 3/4 per cent molybdenum.

160,000-Psi Titanium Alloy

A NEW bar and forging titanium alloy shows promising properties for jet-engine disks and blades, high-strength-light-weight airframe forgings, airframe fasteners, and other parts.

Known as Rem-Cru C-130AMo, the alloy has a nominal composition of 6 1/2 per cent aluminum and 3 3/4 per cent molybdenum. Rem-Cru Titanium, Inc., of Midland, Pa., is accepting orders for it on an experimental basis.

The aluminum-moly titanium alloy offers these advantages over existing alloy grades: (*a*) Improved elevated temperature strength, and creep results; (*b*) excellent time-temperature-stress stability; (*c*) deep hardenability and excellent heat-treated properties. When exposed to high stress in the 600 to 1000-F range, samples show undiminished strength and excellent ductility in subsequent room-temperature tensile tests.

Tensile strengths exceeding 160,000 psi with a good ductility in heat-treated sections over 2 in. thick have been secured in the laboratory.

Furnace-Charging Machines

A LINE of all-hydraulic Auto-Floor furnace-charging machines has been announced by Salem-Brosius, Inc., of Pittsburgh, Pa.

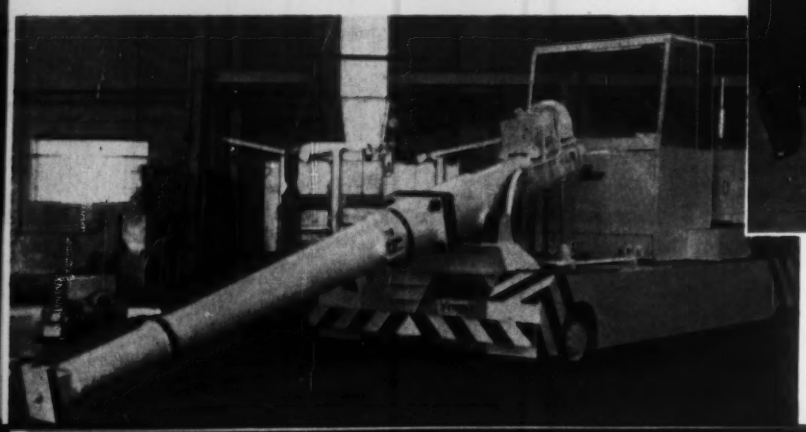
Available in eight sizes ranging in capacity from 2000 to 20,000 lb, the machines are designed to use diesel, gasoline, or propane engines, or plant electricity as the primary power source. They are furnished with boxes for charging scrap, limestone, and other loose materials into melting furnaces or with various designs of tongs to handle ingots, billets, blooms, slabs, and other solid forms.

The rugged, heavy-duty machines are in operation in plants requiring continuous-furnace-charging service. As tricycle-type machines equipped with solid rubber tires, they are extremely maneuverable and will turn on their own wheel base.

The basic power source drives hydraulic pumps which in turn provide power for all operations. These include raising, lowering, tilting, and rotating the box or tongs work head and moving the machine over the charging floor. One man at the hydraulic control pulpit mounted on the machine is in complete control of all functions.

The Auto-Floor furnace-charging machine eliminates the use of cranes, conveyer tables, counterweights, porter bars, and other auxiliary equipment required for furnace charging, and leaves valuable floor space clear of tracks, conveyer tables, and other permanently mounted equipment.

This 2000-lb capacity Auto-Floor charging machine made by Salem-Brosius, Inc., is used to charge and discharge billet and bloom-heating furnaces. Plant electricity is the primary power source for the charger. ▶



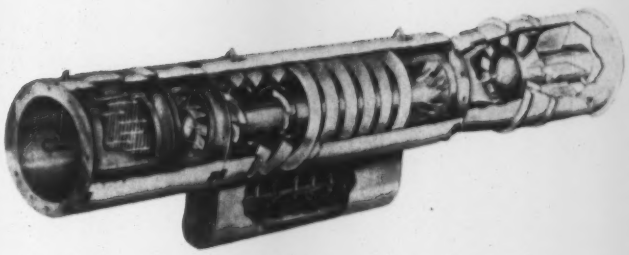
Electric-arc melting-furnace alloy and scrap additions are made with this box charger (box not shown) available from Salem-Brosius, Inc. Machine load-handling capacity is 10,000 lb and the primary power source is diesel engine. ▼

Wet-Inertial Dust Collector

THE Industrial Division of Joy Manufacturing Company, Pittsburgh, Pa., is producing an extremely compact, high-efficiency dust collector, originally developed for use in mines where space was limited and air pollution critical. A new principle results in a unit $^1/_{10}$ to $^1/_{20}$ the size of comparable equipment, a long, small-diameter device that may be connected directly into a plant's duct work.

Secret of the Joy "Microdyne"—classed as a "wet, inertial type"—is an impingement element in which water spray and dust are brought together so violently that each particle of dust becomes encapsulated in a drop of water. This is accomplished near the entering end of the tubular unit. When the impingement element becomes clogged, it is simply reversed, after which it quickly clears itself.

The Microdyne, developed at the Joy research laboratories at Elder's Ridge, Pa., is said to show an efficiency of over 99 per cent in collecting dust particles of five microns or greater.



Dust and spray enter one end of the Joy "Microdyne" dust collector, encounter the impingement element, then pass to the eliminator section where the dust-laden water is removed centrifugally. The slurry is led to a sediment tank. An axial-flow fan completes the device. Low water requirements and low power cost are claimed.

Because of the Microdyne's small size, it can be produced economically in stainless steel for installations where the air pollution is corrosive. It can be purchased in rated capacities up to 64,000 cfm.

Vacuum Remelting Furnace

A FURNACE, described as "a major metallurgical break through," is being made available to the metals industry. Called a consumable-electrode vacuum remelting furnace, it melts titanium, zirconium, high-alloy steels, or other ferrous or nonferrous alloys, which are remarkably free of impurities, and possess improved properties.

The result of development over a 10-yr period, the furnace was jointly announced by Titanium Metals Corporation of America, owned by Allegheny Ludlum and National Lead Company, which has pioneered the use of large consumable-electrode furnaces; Allegheny Ludlum Steel Corporation, which uses the special vacuum process for the melting of superalloys; and the Lectromelt Furnace Division of McGraw-Edison, one of the largest manufacturers of electric furnaces. The latter will manufacture and sell the furnace.

Titanium has advanced from the laboratory to routine tonnage production in less than five years with significant help from the consumable-electrode vacuum remelting furnace. TMCA currently produces 6000-lb ingots in its consumable-electrode melting furnaces at Henderson, Nev. Allegheny Ludlum's standard-size commercial superalloy ingot is 5000 lb, and a new furnace recently completed will melt 12,000-lb ingots.

The consumable-electrode vacuum process developed from the knowledge that even minor quantities of gas impurities and contamination from refractories and electrodes tend to compromise physical properties and high-temperature performance.

The consumable-electrode method, when used for superalloy production, offers distinct advantages over direct-arc furnace melting. A higher degree of cleanliness is attained through removal of nonmetallic inclusions and excess gases.

Better compositional homogeneity through freedom from segregation, improved workability, and ingot soundness result in increased yields, and general improvements in mechanical properties.

Heavy Ion Linear Accelerator

AN atom smasher designed especially to accelerate the nuclei, or ions, of very heavy atoms and therefore called a heavy ion linear accelerator, or "Hilac," has gone into operation at the University of California Radiation Laboratory.

The machine accelerates nuclei of nitrogen 14 to energies of 140 Mev. The new instrument does not compete in energy with such ultra-powerful machines as the Bevatron, which accelerates protons, the nuclei of the lightest element, hydrogen, to 6.2 Bev.

The Hilac may permit the synthesis of elements heavier than Mendelevium, element 101, the heaviest now known. Elements heavier than uranium, element 92, are all synthetic, and are obtained by transmuting uranium nuclei, step by step, into successively heavier atoms.

The instrument will permit a new type of exploration of nuclear forces. It will open up a new field of study of elements 84-90 and be used in studies of the effects on living cells of very heavy particles such as are encountered in cosmic radiation beyond the earth's.

University of California and Yale University scientists jointly developed the machine, and a duplicate is nearing completion in New Haven.

University of California scientists have discovered or participated in the discovery of all elements heavier than uranium. These have generally been made by firing light nuclei from the University's 60-in. cyclotron into either uranium or synthetic atomic nuclei.

With light nuclei, such as alpha particles, as projectiles, elements can be synthesized that are only slightly heavier than the original target element, but these small steps up the periodic table apparently are no longer fruitful.

The Hilac is designed to accelerate the nuclei of atoms ranging up to argon 40, element 18; therefore it may be possible to add very large fragments of matter to target nuclei, bringing about big jumps up the periodic table in single transactions.

Xerography Boosts Naval Output

THE Naval Bureau of Aeronautics recently disclosed that it is using an ingenious, low-cost method of producing enlarged engineering drawings from microfilm to furnish thousands of potential suppliers with necessary drawings and specification sheets when it sends out invitations for bids.

The printing is done from microfilm in a XeroX Copyflo 24-in. continuous printer, an automatic device that produces drawings up to 2 ft wide at a speed of 20 fpm. The time for any one frame is thus only a few seconds.

No ink is used. The prints are dry on emergence and may be used immediately.

The Copyflo continuous printer was developed by The Haloid Company, Rochester, N. Y., pioneers in xerography—a clean, fast, electrostatic process requiring neither water, liquid chemicals, nor darkroom. Heretofore, the process has been used largely for the preparation of offset paper masters from which multiple copies of original documents, such as office forms, letters, price lists, engineering drawings, and the like, are run off on an offset duplicator.

The Copyflo printer operates on the principle that objects of opposite polarity tend to attract each other. Microfilm mounted in aperture cards is projected through a lens system onto a 24-in-wide rotating drum whose selenium-coated surface has been positively charged to make it photoconductive. Where projected light strikes the drum, the charge is drained away, but the positive polarity remains in areas shielded by the opacity in the microfilm, thereby forming a latent image.

This image is made visible by a cascaded, negatively charged, micronized plastic powder that adheres to the drum wherever light does not hit. The resulting image is transferred to roll paper, whose travel is synchronized to the speed of the drum, by the same electrostatic principle: This time it is the paper that is positively charged, and it thus draws the negatively charged powder image from the drum to form the print. The powder is then fused permanently to the paper by heat.

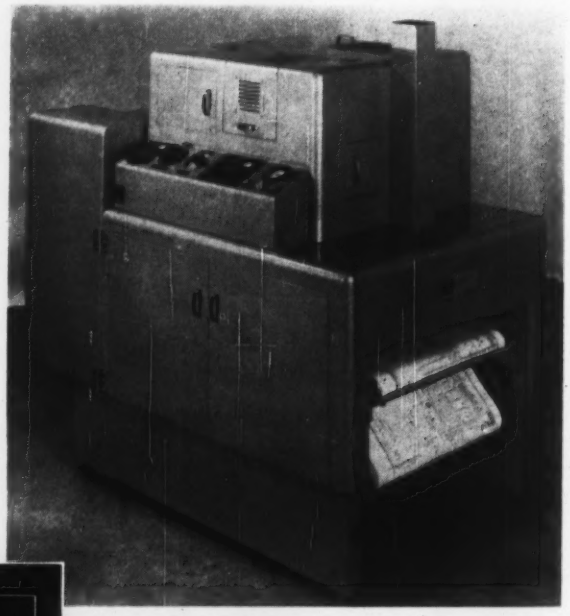
The printing process is completely automatic. Individual microfilm frames are mounted in die-cut apertures of cards punch-coded for various sorting purposes, and emerge from the printer in the order of entry. Up to 400 prints of a single frame may be had via push button that repeats the exposure.

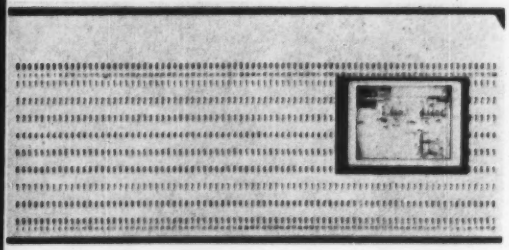
Either positive or negative microfilm may be used, but not intermixed. A "miss" detector is built into the film head and will stop the card-feed mechanism if a card fails to appear. Another function of the detector is to stop the machine when the card stock is exhausted.

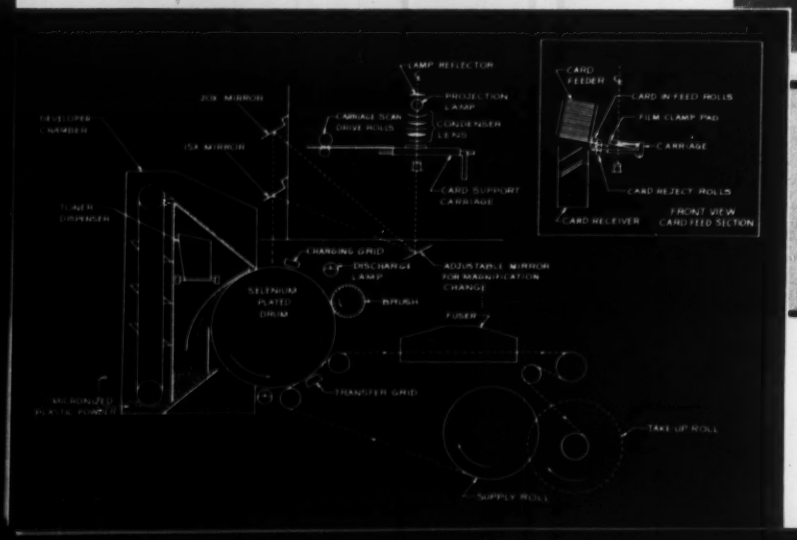
Roll microfilm in either 16 mm or 35 mm may also be used with an auxiliary attachment. The change may be made in ten minutes and no further adjustments are required.

The EAM (Electric Accounting Machine) cards are die cut, framed with adhesive, and mounted with individual microfilm frames by the Filmsort Division of the Dexter Folder Company. Microfilming is done by the Recordak Corporation, a subsidiary of Eastman Kodak Company, and Remington Rand.

Reduction ratios are 16x and 29x. Enlargements in the printer are either 15x or 20x. The Recordak and Remington Rand equipment will reduce A through D-sized drawings onto microfilm for later reproduction by the xerographic printer.

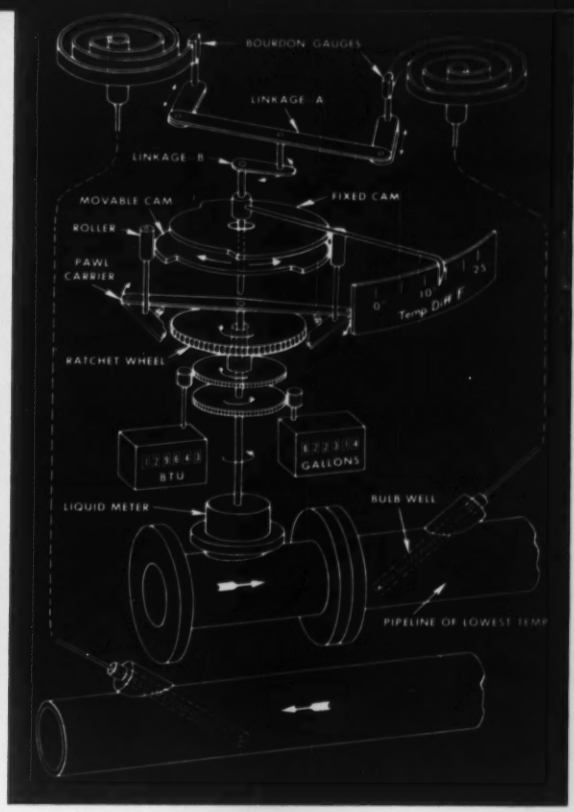






No ink is used in the XeroX Copyflo 24-in. continuous printer, *upper right photo and diagram below,* which turns out 24-in-wide engineering drawings from microfilm at the rate of 20 fpm. The electrostatic process requires neither water, liquid chemicals, nor darkroom. Microfilm mounted in aperture cards, *lower right photo,* is projected through a lens system onto a positively charged selenium-coated photoconductive surface, and makes use of the fact that objects of opposite polarity tend to attract each other.

▲The small Pollux mechanical Btu meter is easily connected directly in a pipeline



Operating diagram for the Pollux mechanical Btu meter ▶

Mechanical Btu Meter

A COMPLETELY mechanical instrument that measures heat in thermal units, and liquid flow in gallons with high precision, is being made by Air Conditioning Equipment Corporation, New York, N. Y. Known as the Pollux Btu integrating meter, it can measure the heat absorbed by a liquid, and the heat removed from the liquid. It can also measure the heating and cooling consumed in individual areas.

The Pollux Btu meter has a wide range of applications. It can be used in metering of central heating and refrigeration plants, and it is especially applicable for measuring the quantity of heating and cooling consumed in individual areas of all types of buildings. It is also adaptable for use with liquids.

The thermal expansion of the mercury in the two temperature-sensitive bulbs, *bottom of diagram*, produces corresponding deflections of the Bourdon gage movements. These act on a linkage which produces an angular rotation proportional to the instantaneous temperature difference indicated on the scale. The integrator is directly connected to the temperature-difference indicator.

The liquid meter drives the liquid counter and the pawl carrier, whose speed of rotation corresponds to the instantaneous rate of flow of the liquid. The pawl engages the ratchet wheel over an angle of rotation whose magnitude depends on the temperature difference, and thus drives the Btu counter. The pawl is engaged and disengaged by the movement of the rollers which run in contact with two disk cams. One of these cams is fixed while the other is connected to the temperature-difference movement. The angle through which the pawl rotates in engagement with the ratchet wheel is thus proportional to the temperature difference, while the rate of rotation of the pawl carrier corresponds to the flow rate.

The mechanism thus continuously forms the product of temperature difference and liquid flow. This product gives the heat removed or added to the liquid.

Pipe Insulated With Aluminum

THE Esso Standard Oil Company's Bayway, N. J., refinery employs 80,000 lb of alloy 3003 sheet, produced by the Aluminum Company of America, to shield $5^1/_2$ miles of large-diameter insulated steel pipe from damaging weather and corrosive industrial-marine atmosphere. The pipe delivers steam from a near-by generating station.

Heat loss is only 5 per cent of that experienced with bare pipe, saving more than $500,000 a year.

To conserve heat and maintain steam efficiency, each new pipeline is wrapped in mineral-wool insulation

A new steam-carrying pipeline system now in operation at Esso Standard Oil Company's Bayway refinery is protected from the weather by corrosion-resistant Alcoa aluminum

manufactured by Baldwin-Hill Company, Trenton, N. J., and jacketed with Alcoa aluminum.

The Trybee Company, Inc., Garfield, N. J., first wrapped the lines with the blanket-type insulation, then added a layer of 15 lb roofing felt. Aluminum sheet in alloy 3003 was cut to size, shaped, and punched prior to reaching the job site. When installed, the easily welded sections were drawn tightly around the felt-covered insulation, and secured with self-tapping screws. Complete weatherproofing was insured by the careful overlapping of adjacent sheets.

At elbows and fittings in the pipelines, mineral wool insulating-finishing cement and asphaltic mastic weatherproofing compound were used in place of aluminum sheet.

NBS Solar Furnace

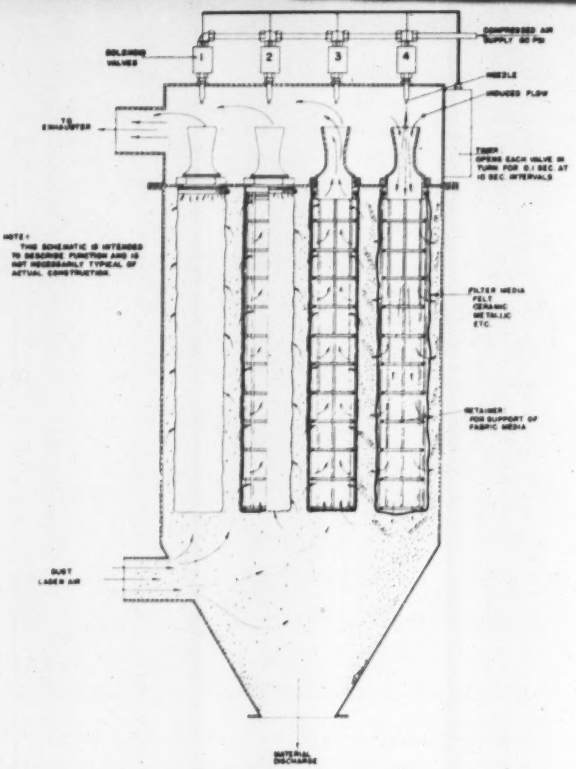
A SOLAR furnace that generates temperatures $^2/_3$ as hot as the surface of the sun, will be used by the National Bureau of Standards to melt refractory materials at temperatures up to 3500 C in a controlled environment free of contaminating agents. Investigations should result in better temperature-resistant materials for atomic reactors, aircraft engines, and guided missiles.

The Bureau's solar furnace was converted from a surplus Army searchlight with a 5-ft-diam parabolic mirror. It collects the sun's rays and focuses them into an intensely hot spot only $^1/_4$ in. in diam. This area can be isolated by closed glass tubing, which can be evacuated or filled with gas of the experimenter's choice. The glass enclosure is not affected by the sun's rays since the image of the sun is unfocused where the light passes through the enclosure and no local heating of the glass results.

The curved mirror faces an 8-ft-sq flat mirror, called a heliostat, which is directed at the sun and reflects the light into the solar furnace. The heliostat is attached to a searchlight mount so that it can be turned to follow the sun. An assembly of photocells with appropriate electronic equipment controls the heliostat driving mechanism in response to the sun's apparent motion.

Besides study of the properties of refractory materials, the solar furnace can be used in the "zone refining" of oxides of zirconium, thorium, or uranium to produce extremely pure samples of those compounds. By means of the solar furnace it may also be possible to grow single crystals of these and similar materials for laboratory studies.

National Bureau of Standards solar furnace converted from U. S. Army surplus searchlight. The furnace can produce temperatures up to 3500 C to melt refractory materials. Flat mirror at *left* collects light and reflects it into the parabolic mirror at *right*.



Internal arrangement of the Mikro-Pulsaire dust collector, showing the reverse jet being applied to solenoid valve number 4, while air continues to be exhausted from bags 1, 2, and 3

Filter-Type Dust Collector

BY MOMENTARILY introducing a jet of high-pressure air through a specially contoured venturi, a new dust collector periodically clears filter bags of clinging material without using internal moving parts. The jet, applied to each bag in sequence by a series of solenoid valves actuated by an electric timer, flows in reverse through the same tube used for drawing the normal exhaust air through the bag.

Varied numbers of 4 or 6-ft-long cylindrical filter elements are combined in the Mikro-Pulsaire Collectors manufactured by the Pulverizing Machinery Division of Metals Disintegrating Company, Inc., at Summit, N. J.

The lack of internal moving parts permits a wide range of materials to be handled, since there is no danger of explosion from a spark, and abrasive materials have no machinery to affect. Metals, carbon black, or any dry powdered material are accommodated. Toxic or hazardous dusts can be handled with a minimum of purging and hazard.

Considerably less cleaning air is required—only 1 to 2 cfm at 60 psig for each 1000 cfm cleaned.

Units which are made in sizes from 400 and 600 cfm to 3350 and 5000 cfm require less space than comparable sizes in other types. Costs of the units, about 80¢ per cfm delivered, are now cheaper than those for the manufacturer's own ring type and will probably soon be competitive with, or cheaper than, the shaking-bag type.

An unusually high efficiency in dust recovery of 99.9 per cent has been recorded in tests as well as in field performance.

There is almost no maintenance. Filter bags, which cost $40 apiece and had to be replaced every 10 days to

two weeks in shaking or traveling-blow-ring-type collectors, last up to six months.

Bags made from wool felt, and Orlon—good for 250 F, or Teflon—good for 390 F, are being used. Experiments at 600 F in a cement-plant installation have demonstrated practicability at that temperature. Competition with the electrostatic precipitators used in power-plant installations should be possible, particularly if glass-wool material can be developed that will have the proper pores.

Infrared Versus Radar

INFRARED may soon replace radar in many military applications, according to a General Electric missile engineer.

Speaking at the 26th meeting of the Western Section of the Infrared Information Symposia held in May at the Naval Ordnance Laboratory, Corona, Calif., Elton L. Bischoff stated that "infrared is developing to the point of becoming extremely useful for missile guidance and detection."

"Infrared is now being readied for advanced military applications and may ultimately be used as navigational aids to space flight."

Opaque Windows for Infrared

THE Raytheon Manufacturing Company, Waltham, Mass., is currently fabricating custom-designed high-precision infrared optical components from high-purity silicon and germanium.

Silicon windows, lenses, and prisms are useful to temperatures of from 200 to 300 C, and have good resistance to mechanical shock. The 0.1-in-thick windows transmit more than 30 per cent of the incident radiation over the entire range from 3 to 11 microns. When treated with an inexpensive antireflection coating, developed for the purpose, they transmit more than 90 per cent of the incident radiation at 3.5 and 4.3 microns.

The optical applications were an outgrowth of fundamental research on the properties of silicon, which established that single crystals of silicon grown exactly as for semiconductor-device production, met the most exacting optical specifications. Costly further purification was eliminated since a tenfold reduction in the impurity constant of semiconductor-grade silicon made no significant increase in infrared transmission.

It is now logical to consider one-piece single-crystal sections of a wide variety of shapes up to 6 to 8 in. in diam. The fabrication of even larger infrared optical elements may become practical as a result of techniques now under investigation.

Nuclear Briefs

▶ Fusion Power Still Distant

"FIVE additional years of research will be required to make possible a realistic appraisal of the fusion process" for power production, according to Dr. Guy Suits, General Electric vice-president and director of research. "In 10 years we may be at the point of technical feasibility; pilot-plant production of fusion power will not begin for 20 years; and competitive power production lies beyond that."

During this period of discovery and development, the production of power by fission, which is technically feasible today, will rapidly become competitive with older energy sources, he predicted, adding that experience accumulated in producing atomic power by fission will be invaluable when fusion becomes practical.

▶ Future Energy Requirements

"The most optimistic view," according to W. Kenneth Davis, Mem. ASME and director, Division of Reactor Development, U. S. Atomic Energy Commission, "would appear to be that even cheap nuclear power would be able to supply only 20 or 25 per cent of our energy requirements by the year 2000. What can man count on to supply the balance? There is no ready answer to this most disturbing long-range problem. A new way of storing energy, preferably electrical energy, in large amounts in some light, cheap, and safe form might provide the answer, and permit nuclear, and eventually thermonuclear electric energy to provide the increasing demands, but this is remote at the present time."

Mr. Davis' remarks were delivered on June 3 at the 8th Annual Conference on Industrial Research.

▶ Reactor Periscope

What is believed the world's longest periscope, almost three times as long as those on conventional submarines, has been constructed by General Electric Company engineers and installed at the AEC's National Reactor Testing Station in Idaho Falls, Ida., to aid in development work on a nuclear propulsion system for aircraft.

The 90-ft aluminum tube, with an intricate mirror and lens system, permits atomic workers to sit safely behind heavy shielding while they watch the performance of a nuclear reactor being tested in the Government's Aircraft Nuclear Propulsion development program.

Motor-driven scanning mirrors, located less than a dozen feet from the powerful source of radiation inside the reactor, transmit images to observers at the safe ends of the periscopes.

A small control console located beside the observer enables him to swing or tilt the scanning mirrors in any direction so that the reactor can be viewed from any angle.

▶ Isotopes in Aircraft Manufacture

Radioactive isotopes are being used as trace elements by Douglas Aircraft Company, Santa Monica, Calif., for precise nondestructive measurement of the thickness of sprayed coatings, measurement of component concentration of plating solutions, and the comparison of efficiency of various methods of sealing anodic coatings.

Other uses include diagnosing the cause of failure in flash welds, determining the rate of deterioration of fuel-tank sealants by various modern fuels, determining the amount of hydrogen in liquids by beta-ray absorptiometry.

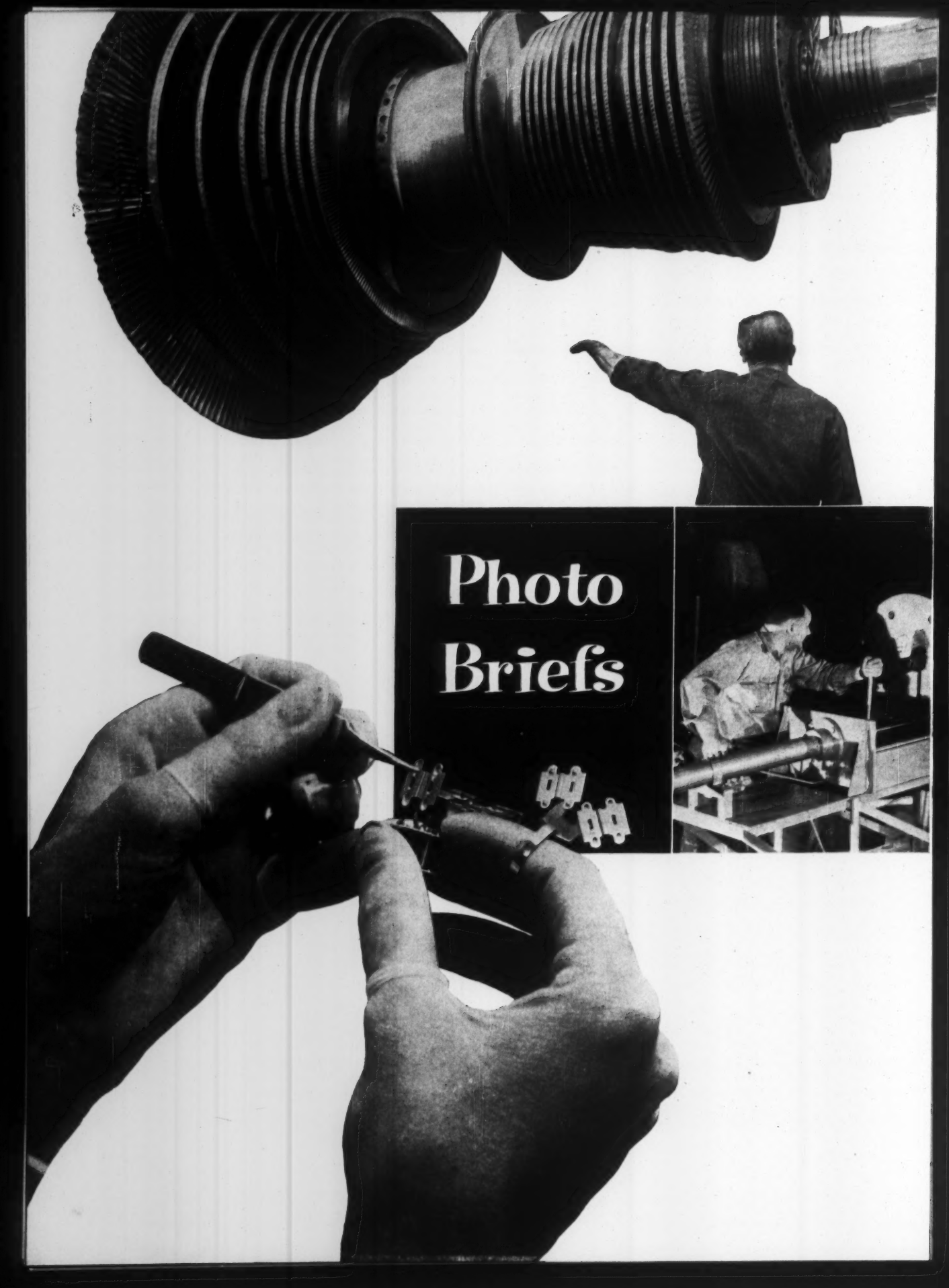
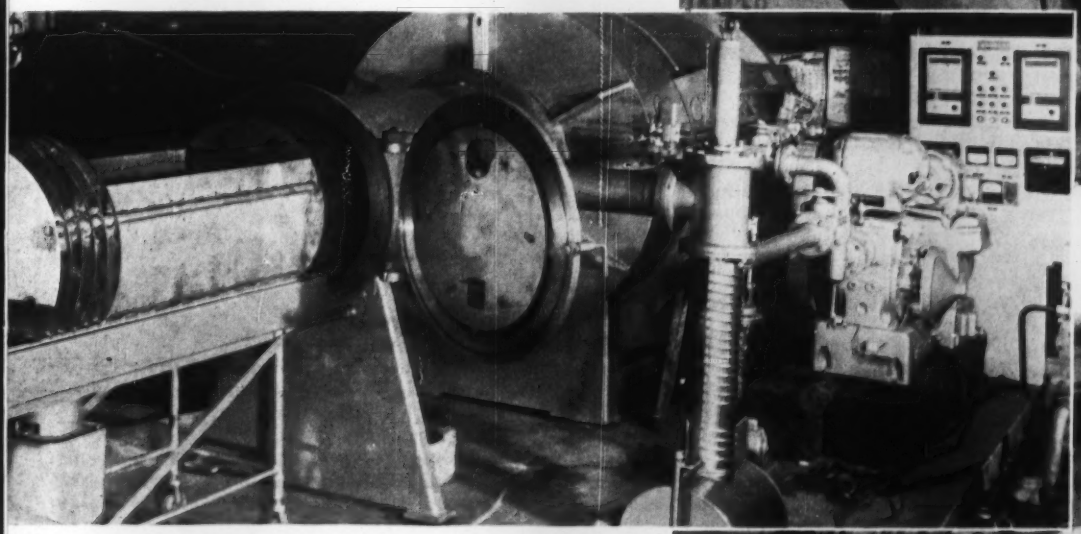


Photo
Briefs

◀ **Turbine Spindle for Shippingport Nuclear Power Station.** The 100,000-kw 1800-rpm steam turbine will weigh approximately 1,300,000 lb, be nearly 81 ft long, and capable of handling 1,400,000 lb of steam per hr. Westinghouse is contractor with the AEC for the nuclear reactor; and Duquesne Light Company of Pittsburgh, Pa., is financing and building the electric-generating portion and will operate the power plant.

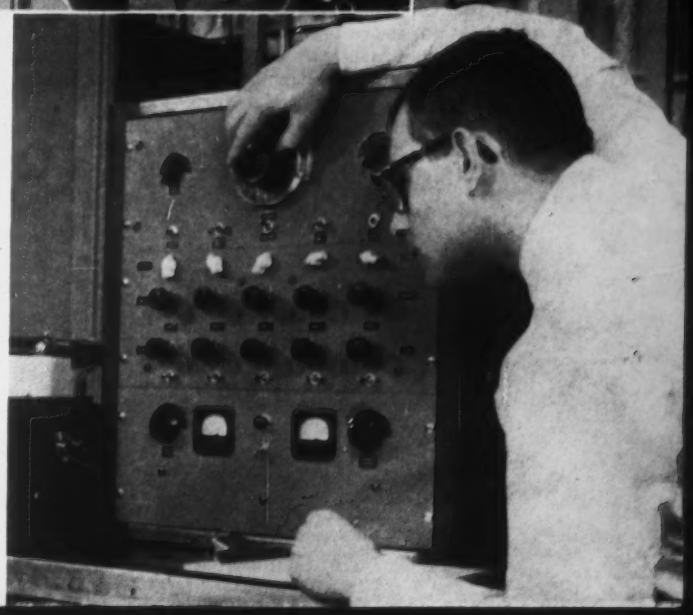
▶ **Full-Pressure Stratosphere Suit.** This rubber and nylon suit developed for the Navy by B. F. Goodrich will protect flyers against loss of cabin pressure at altitudes up to 80,000 ft. Containing its own communication, oxygen, and ventilation systems, it retains its life-saving pressure after a pilot bails out, to keep him afloat and safe from exposure in cold water.

▼ **Horizontal Retort Vacuum Furnace.** One of two identical units developed by the Vacuum Equipment Division of F. J. Stokes Corporation, Philadelphia, Pa., for the Martin Company, Baltimore, Md., for experimental and limited-scale-production vacuum brazing of aircraft components at temperatures as high as 2150 F, or for degassing, annealing, or other heat-treatment operations. Parts are loaded into the movable boat which is driven into the two-zone vacuum chamber at right by a hydraulic ram. Pressure is normally reduced to about 20 microns, and can be drawn to below 1 micron.



◀ **Magnetic Ring Simplifies Assembly.** A small U-shaped Alnico 5 magnet, worn as a ring, simplifies assembly of parts for electronic tubes at the Owensboro, Ky., plant of General Electric. A 12 per cent step-up over the time spent in picking up the parts individually from bins resulted.

▶ **Testing Temperature Coefficients of Resistance.** Temperature coefficients for fine-gage copper-nickel resistance wire can be determined within ±0.5 ppm per ohm per deg C over temperature intervals of 80 deg or more with this special equipment developed by engineers at Hoskins Manufacturing Company, Detroit, Mich. Five groups of specimens can be accommodated at one time, and the unit may also be used in conjunction with a recorder to plot a "change-in-resistance" curve for each specimen over the entire temperature range.



European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

Bucket Excavator on Crawler Track

Among the stands in the open-air section of the German Industries Fair at Hanover (see July, 1957, issue of Mechanical Engineering, p. 672), that of the firm of Orenstein-Koppel und Lübecker Maschinenbau A. G. always attracts attention, usually by some development in dredging or excavating. In this respect the 1957 Fair was no exception, probably the chief center of interest being an excavator which is, in effect, a small-scale application of the design principles embodied in the enormous wheel-type machines which the firm constructed some two or three years ago for digging the soft brown coal which is plentiful in Germany.

This new machine is made in two sizes with bucket capacities of 25 liters and 50 liters, respectively, giving rated outputs of 186 and 305 cu m per hr. The buckets are carried on the periphery of a hollow wheel, mounted on the end of a boom which can be raised or lowered hydraulically and which also carries a belt conveyer. A revolving disk projects into the interior of the wheel and over the end of the conveyer. As each bucket comes to the top, its contents fall onto the disk and thus are fed onto the conveyer. Scrapers insure that each bucket is completely emptied, and another scraper cleans the disk. The central column supports the boom and rests on a turntable on the frame which is mounted on crawler tracks, and can swing through the full 360 deg. At the rear is another boom on which runs a discharging conveyer for loading trucks or dump cars, or for discharging to a spoil heap. This discharging conveyer can be slewed to either side of the center line of the cutting boom, to the extent of 100 deg in the case of the smaller machine, and 105 deg in the larger. The conveyers are troughed, the side rollers of the three-roll idler sets having an inclination of 30 deg above the horizontal. The straight rollers forming the lower idlers are fitted with helical plates, welded onto them, and "handed" to right and left; thus, any adhesive material, such as clay, which might remain on the conveyer belt is scraped away and discharged to the sides.

The following dimensions and details relate to the larger machine. The smaller is not greatly different in over-all measurements, the main differences being in the diameter of the bucket wheel and the length of the discharging boom, though there is also, of course, a

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

Parking Belt for Automobiles

Parking automobiles in large cities is becoming a problem in most European cities, though it is not everywhere as acute as in London and Paris. Most new office blocks are being built to take cars in their basements, but this is an expensive method of parking unless they can be closely packed, and then the further problem arises of getting them out individually, in an order which may be very different from the order in which they were put in. The steel firm of Krupp, of Essen, Germany, has devised a "mechanical garage" which was shown at the Hanover Fair. It consists of two endless chains running on sprockets at the ends of a frame which may be of any desired length. Between the chains are trays, each large enough to accommodate one automobile, which is run on from the side of the structure (*left*) so that its length is across the width of the conveyer formed by the two chains. The trays (*center*) rest on rollers at their corners and these run on two separate tracks. At the end of the frame, one track projects beyond the other, with the result that the tray remains level as it mounts

Bucket wheel excavator by Orenstein-Koppel und Lübecker Maschinenbau A. G.; *below,* rear view showing discharge boom which can be swiveled 105 deg to either side; *at right,* bucket wheel and end of boom showing revolving disk which deposits excavated material on conveyer. The machine can be supplied with diesel-electric or all-electric drive.

marked difference in the total weight. For the machine with bucket capacity of 50 liters, the cutting height is variable, between 5 ft and 20 ft 8 in. above the level on which the crawler tracks are standing. The wheel will cut to 14 in. below ground level. The diameter of the bucket wheel is 7 ft 11 in. (for the small size, it is 5 ft 11 in.) and the outreach is 24 ft 4 in. The discharging belt boom has an outreach of 55 ft 8 in., and the boom can be raised or lowered to bring the center of the belt drum to any desired height between 2 ft 8 in. and 19 ft 9 in. above ground level. The belts are 26 in. wide.

The machine can be supplied either with diesel-electric or all-electric drive. In both cases the total weight is about the same, 55 long tons, which is about 20 tons more than the weight of the smaller machine. In both cases also the wheel has six buckets and can be operated at six speeds.

The crawler chassis is carried on two tracks 3 ft wide and is 16 ft long × 13 ft 2 in. in width over the tracks. It has a traveling speed of about 16½ fpm. The tracks are supported on eight rollers, linked in pairs. The forward two pairs and the after two pairs are similarly coupled by flexible linkages so that the rollers can "float" vertically and adjust themselves to uneven ground. The power consumption of the large machine is 100 kw and of the smaller, 60 kw.

(*right*) from the lower deck of the "garage" to the upper deck. A motor drives the chains in either direction at will, to bring any desired tray opposite to the opening in the side where vehicles are run on and off. It is not essential, therefore, that the trays should be loaded in any particular sequence; any tray that is vacant can be quickly brought to the loading point when a car drives in, and any car that is on the trays can be as quickly positioned opposite to the exit. As designed at present, the "mechanical garage" can be constructed to take up to 60 automobiles.

Coal-Fired Power Station

The British Minister of Power has reminded the public that, while he has authorized a large program of nuclear-power-station construction, the demand for electricity is increasing so fast in the British Isles that there can be no slackening in the construction of coal-fired stations.

For some time the Central Electricity Authority, which is the British Government agency for the generation of electric power, has been looking for a site in South Yorkshire, which is one of the most important English coalfields. They have found one at Thorpe Marsh, about four miles northeast of Doncaster, where it is proposed to erect a steam power station, coal-fired, to provide an electrical output of 1,100,000 kw, to be generated in a plant of 550,000-kw unit capacity. This is twice as much as the capacity of any generating unit so far planned for any other part of the country, and it is believed to be the largest yet projected anywhere in the world. The approximate cost of the station will be £40 million (112 million dollars) and its coal consumption will run to something over 2½ million tons a year, which is more than 1 per cent of the entire British coal production at the present time. It is hoped to bring the station into service in the early 1960's, but no definite date can be given yet for the start of construction, as negotiations are still proceeding with the landowners and public authorities affected.

ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings

Nuclear Engineering

Heat Transfer "Beyond Burnout" for Forced-Convection Bulk Boiling, by L. H. McEwen, J. M. Batch, Assoc. Mem. ASME, D. J. Foley, and M. R. Kreiter, Hanford Laboratories Operation, General Electric Company, Richland, Wash. 1957 ASME Semi-Annual Meeting paper No. 57—SA-49 (multilithograhed; available to April 1, 1958).

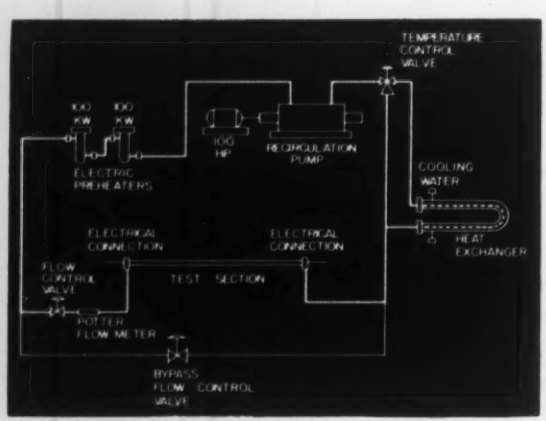
BOILING heat transfer is of considerable current interest. Of particular importance in the boiling process is the characterization of conditions called burnout. This is most commonly considered as a point at which a transition from nucleate boiling to film boiling occurs.

At the point called burnout a relatively small increase in heat flux can cause an immediate increase in the temperature difference between the heated surface and the cooling media. If the temperature difference becomes excessive at the burnout point, the heated surface will be destroyed by melting.

If melting does not occur after the transition from nucleate to film boiling, the heat flux can be increased or decreased along the film-boiling part of the boiling curve under steady-state conditions. From these film-boiling conditions, however, the heat flux must be decreased to a value considerably below burnout to effect a transition back to nucleate boiling.

Burnout can occur under conditions of forced or natural circulation and with the bulk fluid temperature at or below the boiling point. Burn-out investigations have been made by many previous investigators but in most cases the test section used has been relatively small. Correlations have been written for forced-circulation subcooled burnout, but so far as is known no truly satisfactory general correlation has yet appeared in the literature concerning forced-circulation bulk-boiling burnout. The authors are engaged in a general study of the phenomenon, one phase of which involves horizontal geometries. The work described here represents only a portion of the study and deals with experiments aimed at securing improved understanding of heater surface-temperature behavior in the vicinity of burnout.

It is the purpose here to present experimental boiling-burnout data which indicate that, for a relatively large solid heated test section in a horizontal position, the transition from nucleate to film boiling is continuous rather than instantaneous, and that film boiling can occur on the top of the test section while nucleate boiling is taking place on the bottom. Presented in the paper are the results of experiments with forced-circulation annular-flow heat transfer to boiling water at 1500-psia pressure in a horizontal electrically heated test assembly. The experiments comprised measurements of heater-rod surface temperatures near and in the region of transition between nucleate and film boiling at heat fluxes of from 100,000 to 396,000 Btu/hr sq ft and with steam qualities up to 56 per cent by weight. Apparent phase stratification led to heater-rod temperatures which indicated a smooth and continuous transition between nucleate and film boiling.



Sketch of apparatus used in experiments with forced-circulation annular-flow heat transfer to boiling water at 1500-psia pressure in a horizontal electrically heated test assembly

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Nuclear Weapons Engineering, by M. D. Martin, Mem. ASME, University of California Radiation Laboratory, Livermore, Calif. 1957 ASME Semi-Annual Meeting paper No. 57—SA-32 (multilithographed; available to April 1, 1958).

NUCLEAR weapons are currently the object of considerable engineering effort. This paper summarizes briefly the areas which are currently requiring the greatest engineering attention.

Free-fall bomb-type nuclear weapons present problems in the design of the airplanes which carry them. Aircraft which carry the bombs internally impose restrictions of length, diameter, weight, and method of attachment, on the bomb designer. Similarly, those which carry their weapons externally, attached to the wings or fuselage, present problems of streamlining. Operational problems such as the escape of a delivery aircraft and its crew from its own weapon are also in need of solution by the weapons designer, the aircraft designer, and the representative of the aircraft pilot.

Nuclear warheads of high-speed missiles present further problems for the weapons designer. Missiles impose severe restrictions of size and shape. Warheads must also be designed to withstand large amounts of vibrational energy over a wide spectrum of frequencies.

Other considerations which must be made in the areas of nuclear weapon design are those of shipping and storage. Weapons must be capable of being shipped by truck, airplane, railroad car, and ship, and they must also have built-in safety features which insure that accidental nuclear detonations do not occur.

Auxiliary components, usually electronic in nature and located in the fusing and firing circuits, must be designed for optimum reliability.

A description of the types of test to which nuclear weapons are subjected is also presented.

●

Control-Rod and Drive Mechanism for the Engineering Test Reactor, by P. M. Clark and W. A. Zschaler, Assoc. Mem. ASME, General Electric Company, San Jose, Calif. 1957 ASME Semi-Annual Meeting paper No. **57—SA-80** (multilithographed; available to April 1, 1958).

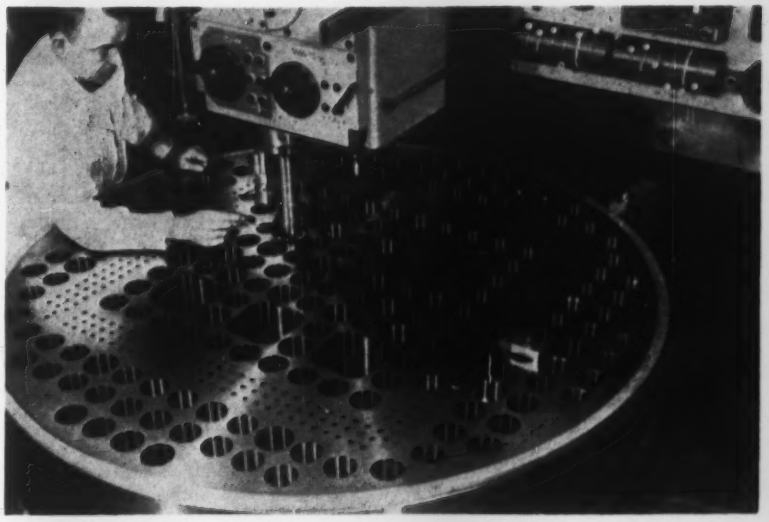
THE Engineering Test Reactor (ETR) is designed to provide a high thermal neutron flux for the irradiation of in-pile facilities. In order to accommodate the requirements of the engineering test reactor, a control-rod and drive assembly has been designed and a prototype tested. The solution of specific mechanical, space, handling, heat-generation, and hydraulic problems is described in this paper.

The control-rod design endeavors to accomplish the following goals: (*a*) Separable sections, (*b*) low hydraulic-pressure drop, (*c*) high heat-transfer rate, (*d*) rapid "scram" (emergency insertion of control rods) movement, (*e*) safety black-rod control, (*f*) gray-rod control, (*g*) ease of maintenance, (*h*) reliability.

The piston section, the fuel section, the shock section, and the guide tube are the subassemblies which make up the control rod. To complete the assembly, the guide tube is placed within the reactor, followed by the insertion of the shock, fuel, and poison sections which are latched together to form an integral rod. The guide tube is about 15 ft long while the control-rod assembly is about 12 ft long. The cross section of the guide tube is 3 in. square by a $^{7}/_{32}$-in. wall. The control rod is about $2^{1}/_{2}$ in. square in cross section with the poison and shock sections having a basic wall thickness of $^{7}/_{32}$ in.

A roller-bearing system is used between the guide tube and the control rod to prevent rubbing. The guide tube is supported by the lower head, an intermediate support plate, the grid plate, and a portable upper support frame. The guide-tube system with the bearings mounted on the rod itself allows the control-rod assembly to be confined within a 3-in-square cross section throughout the reactor vessel.

The control-drive mechanism is required to move the control rod at a constant speed and to position it without drifting. The mechanism must be capable of releasing the rod when a scram signal is received. It must also include a shock absorber to arrest the motion of the rod at the end of its scram stroke. Because of the control-rod grouping in the core, the drive cannot exceed a 6-in. diameter. The mechanism also must be conservatively designed for long, trouble-free life. The arrangement of the components should be such that routine maintenance can be easily accomplished with a minimum exposure of personnel to radiation.



Engineering Test Reactor grid plate during the rough machining operation. Note the unfinished large experimental holes which will be square when the machining is complete. The area of the small holes is the beryllium reflector region with the aluminum reflector holes along the perimeter.

●

Engineering and Construction of the Engineering Test Reactor—Part II, by P. D. Bush, A. T. Chute, E. A. Dukleth, A. L. Lindsay, T. E. Stephens, W. M. Sybert, Mem. ASME, and H. D. Young, Kaiser Engineers, Inc., Oakland, Calif. 1957 ASME Semi-Annual Meeting paper No. **57—SA-31** (multilithographed; available to April 1, 1958).

CONSTRUCTION of the 175-megawatt Engineering Test Reactor (ETR) has been completed at the National Reactor Testing Station in Idaho. The ETR facility consists of such major equipment as a reactor, storage canal, primary and secondary coolant systems, experimental facilities, associated buildings, and extensions to existing utilities. It is designed to perform engineering tests on fuel elements and components of nuclear plants. A basic concept in the design of the ETR was that the area above the core be free from control mechanisms in order to provide space for the equipment of experimenters. This is a distinct deviation from most previous reactor designs wherein devices such as control rods, fission chambers, and ion chambers penetrated the top head.

This paper, and its companion paper, Part I, 57—NESC-106 (see May, 1957, issue of MECHANICAL ENGINEERING, p. 476), describe some of the usual and unusual problems which have arisen during the course of the project. The reactor vessel and the considerations which preceded the fixing of its dimensions, are discussed.

The primary coolant system is based upon a reactor inlet temperature of 110 F, and a flow of 44,000 gpm pressurized to 200 psia in order to prevent boiling in the core, and its design is also detailed. Materials and fabrication which were encountered in the design of ETR are noted. One of the major material problems was that of procuring an adequate grid-plate forging, a large forged disk of solid stainless steel 9 in. thick × 65 in. diam. Considerations which entered the design of the thermal shield and the concrete biological shield are presented.

●

Design and Construction Problems of APPR-1, by Kenneth Kasschau, ALCO Products, Inc., Schenectady, N. Y. 1957 ASME Semi-Annual Meeting paper No. **57—SA-91** (multilithographed; available to April 1, 1958).

DESIGN and construction problems of the Army Package Power Reactor which has been constructed at Fort Belvoir, Va., are discussed in this paper. A large dome-shaped structure, the vapor con-

tainer houses the primary loop consisting of the reactor, steam generator, and primary coolant circulating pumps. The reactor is located in the pressure vessel in the lower left-hand corner of this container. It is a pressurized water reactor employing uranium-oxide highly enriched in U-235 isotope. The uranium, in the form of uranium-dioxide, is encased in stainless-steel plate-type fuel elements. The core is 20 in. square × 22 in. high, and contains a fuel charge of about 22 kg of U-235.

One of the problems which arose early in the program was the design of the vapor container. It was necessary to provide a structure which would prevent a dangerous release of the approximately 100,000,000 curies of radioactivity in the APPR-1 at equilibrium. The design of the vapor container was predicated upon the maloperation of the plant in such a way as to release the maximum amount of energy.

Solutions to the problems of design of the control-rod drives, the control rods, the primary loop equipment, and the primary circulating pumps are also presented.

●

Preliminary Operation—Shippingport Atomic Power Station, by E. M. Parrish, Mem. ASME, Duquesne Light Company, Pittsburgh, Pa. 1957 ASME Semi-Annual Meeting paper No. **57—SA-55** (multilithographed; available to April 1, 1958).

PRELIMINARY operation of a conventional station can be defined as the steps necessary to insure that the installed equipment is capable of operating as designed, both as individual items and as a unit. The preliminary operation of the Shippingport Atomic Power Station will fit this definition, but will require nine months of actual testing to complete and will consist of approximately sixty formal tests in addition to equipment check-outs. A similar program in a conventional station would consist of equipment check-outs and a few formal tests, requiring approximately three months to complete.

There are four phases of preliminary operation.

1 The first phase, inspection and checking of equipment as installed, insures that the equipment has been installed properly and that it can be operated safely for tests.

2 The second phase, precritical system testing, determines that the various systems upon which the core is dependent will operate in accordance with design, checks the integrity of the systems and equipment, and provides valuable operational data.

3 The third phase, initial critical testing, determines that the reactor core can be operated safely, and provides the necessary data to prove the various core calculations.

4 The fourth phase, initial power operation, determines that the station is capable of carrying load.

This paper is confined to a discussion of the first two phases. These are currently in progress.

●

Nuclear Power in Britain, by W. R. Wootton, Babcock & Wilcox, Ltd., London, England. 1957 ASME Semi-Annual Meeting paper No. **57—SA-57** (multilithographed; available to April 1, 1958).

THE incentive for the ambitious program of application of nuclear energy in Britain is the familiar one of increasing shortage of fuel and power arising from increasing industrial production. Coal still provides about 85 per cent of Britain's total energy requirements, although steps recently have been taken to increase the use of fuel oil. All additional economic sources of energy have to be given fullest consideration and there is indeed scope for the development of any form of energy that shows promise of being competitive.

A Government White Paper published in February, 1955, outlined a program of nuclear power intended to take over a major part of the electricity production in Britain as soon as possible. It provided for 12 nuclear power stations to be commissioned by 1965, aggregating between 1500 and 2000 megawatts in electrical output. The program was flexible and was liable to be changed in size and in timing. The earlier stations in this program, perhaps the first eight, would be developments of Calder Hall, while the later ones might be of a different and of course more advanced design. The purpose of the present paper is to correlate and condense the available literature into a concise account of the application of nuclear power in Britain, its background, and its prospects.

●

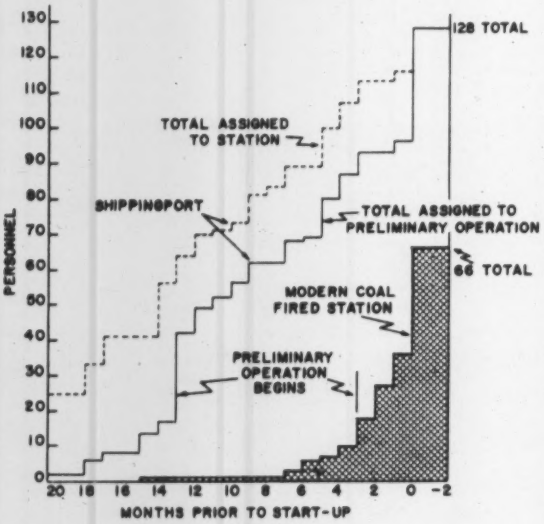
The Prospects for Economic Atomic Power, by D. P. Herron and A. Puishes, Mem. ASME, American Radiator & Standard Sanitary Corp., Redwood City, Calif. 1957 ASME Semi-Annual Meeting paper No. **57—SA-25** (multilithographed; available to April 1, 1958).

THE costs of generating electricity from nuclear power plants are compared with corresponding costs from conventionally fueled power plants. Prospects for reducing the various components of nuclear power costs are examined.

Limitations on atomic power plants are discussed with respect to the requirements of the small, compact reactor core, the materials of construction, and the severe conditions of corrosion and temperature encountered in nuclear plants.

Construction costs in nuclear power plants are compared to those in conventional plants. Turbogenerator costs and the high costs of heat-generating systems which account for an appreciable portion of the additional costs of nuclear power plants over conventional plants are outlined.

Fuel costs in nuclear power plants are also higher. Fuel burnup contributes to the increased cost of operating a nuclear power plant. The author discusses means of fuel processing and of reducing fuel-element costs and other major areas of cost reduction.



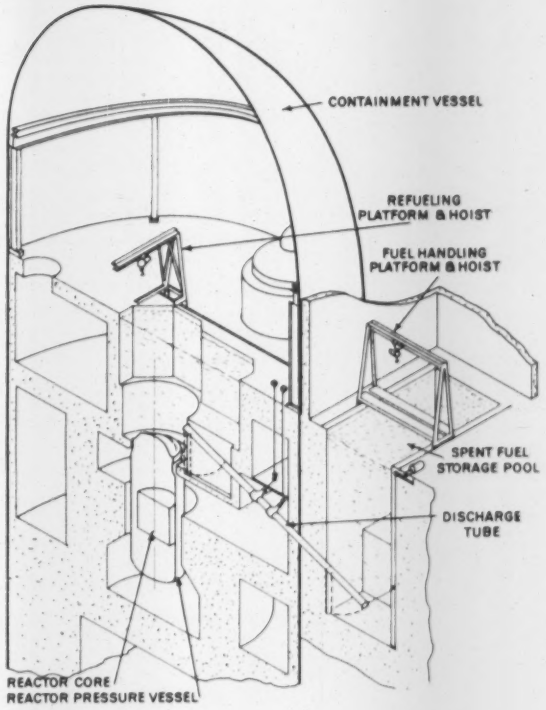
Comparison of personnel required for preliminary operation of a conventional power station versus Shippingport Atomic Power Station

The importance of the power economics of several different nations is pointed out as it affects the comparison of nuclear plant types.

●

Refueling Systems for Boiling-Water Reactors, by C. D. Carroll, Assoc. Mem. ASME, General Electric Company, San Jose, Calif. 1957 ASME Semi-Annual Meeting paper No. **57—SA-79** (multilithographed; available to April 1, 1958).

THE refueling operation for a boiling-water reactor consists of opening the pressure vessel, removing some of the radioactive fuel assemblies from the reactor core, placing new fuel assemblies in the core in place of the removed assemblies and closing the pressure vessel—all to be done from behind various amounts of radiation shielding. Associated with the refueling operation are operations of storage of the new and radioactive used fuel, packing and shipment of the radioactive fuel, disassembly of the radioactive fuel, and so on. Differences in design of the refueling equipment are illustrated by equipment from the 180,000-kw nuclear power station being built for the Commonwealth Edison Company by the General Electric Company, and a 12,500-kw nuclear power station.



Cutaway view of 12,500-kw power station. Containment vessel is an upright cylinder which houses only the reactor.

A typical equipment list for these refueling systems would include a reactor crane, pressure-vessel head removal tools, pressure-vessel-head storage fixtures, refueling platform, viewing aids, fuel-grappling tools, underwater lights, transfer carriers and associated fuel racks, storage racks, a shipping cask, and a shipping-cask crane.

Petroleum

The Control of Manpower and Material by Planning and Scheduling Maintenance Work, by C. C. Carmine, Tidewater Oil Company, Associated, Calif. 1957 ASME Semi-Annual Meeting paper No. **57—SA-68** (multilithographed; available to April 1, 1958).

MAINTENANCE in a modern oil refinery is subject to widely fluctuating demands involving intermittent peak maintenance loads. This presents a problem in how to handle or control the manpower and material required. This paper is premised on that solution of the problem which provides for a relatively fixed maintenance complement based upon some intermediate-size peak maintenance load. The solution is complex, involving a constant of the fixed maintenance complement and a number of changing variables. A positive control over maintenance manpower and material is necessary to conserve both and to meet commitments. This may be achieved through a formal system of planning and scheduling maintenance work incorporated in a proper maintenance organization and functioning in conjunction with procedures for the written authorization of all maintenance jobs.

●

A Preventive Maintenance Plan for Gas-Products Plants and Related Operations, by J. E. Shannon and R. H. Illingworth, Mem. ASME, Magnolia Petroleum Company, Dallas, Texas. 1957 ASME Semi-Annual Meeting paper No. **57—SA-69** (multilithographed; available to April 1, 1958).

THIS paper discusses the details for setting up a simplified preventive maintenance program for gas-products plants and field facilities. The plan does not call for a multitude of forms or for detailed records. Records are such that they can be kept by the operating and maintenance personnel without additional clerical help. The records do provide a means of checking the maintenance and maintenance-crew work loads. Adjustment of the records to take care of emergency situations is simple, and the plan can be adapted easily for such situations regardless of plant size.

●

Economics of Contract Maintenance, by Alan McCone, Catalytic Construction Company, Philadelphia, Pa. 1957 ASME Semi-Annual Meeting paper No. **57—SA-75** (multilithographed; available to April 1, 1958).

MAINTENANCE operations are the largest single item of operating cost in petroleum and chemical plants. The factors influencing the cost of maintenance are reviewed. The various types of contract maintenance presently in use are explored by the author, and their advantages and disadvantages are presented. Case histories of actual maintenance operations conducted by Catalytic Construction Company for various refiners over a period of years are reviewed. On the basis of this actual operating experience, the conclusion is made that substantial savings can be achieved by contracting for maintenance as a professional engineering service.

Power

A Discussion of an Application of Automatic Digital-Data-Collecting System to Boiler Testing, by J. H. Bail, West Penn Power Company, Greensburg, Pa., C. E. Jones, Assoc. Mem. ASME, The Babcock & Wilcox Company, Alliance, Ohio, and H. T. Hoffman, Bailey Meter Company, Cleveland, Ohio. 1957 ASME Semi-Annual Meeting paper No. **57—SA-61** (multilithographed; to be published in MECHANICAL ENGINEERING; available to April 1, 1958).

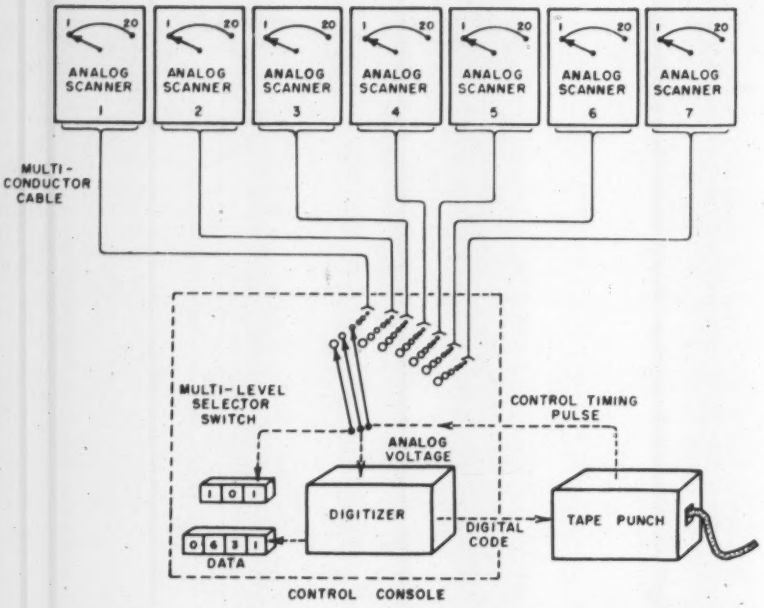
THE equipment described in the companion paper, 57—SA-58, was installed on The West Penn Power Company's Springdale Unit No. 8 for the purpose of gaining experience with this type equipment for boiler testing. This paper describes this installation, the tests conducted, and the results obtained. The number of data points installed, the accuracy obtained, the quality of the results, and a comparison of manual and automatic testing techniques are presented. Some possibilities for the future are explored.

●

An Automatic Digital-Data-Collecting System for Use in Central Stations, by W. T. Hage, The Babcock & Wilcox Company, Alliance, Ohio, and H. T. Hoffman, Bailey Meter Company, Cleveland, Ohio. 1957 ASME Semi-Annual Meeting paper No. **57—SA-58** (multilithographed; to be published in MECHANICAL ENGINEERING; available to April 1, 1958).

THE accuracy, flexibility, and ability to process large masses of data make digital-data-processing equipment an attractive means for detailed process analysis. This paper and a companion paper describe what is believed to be the first application of such equipment to a large modern central-station boiler. This paper presents digital-data-collecting equipment developed by the Bailey Meter Company and The Babcock & Wilcox Company for use in central stations. The system described prepares a punched paper tape for transmitting the data to a central computer for processing. The results may be returned to the point of origin via teletype to provide a fast feedback of results.

The first DATAK (data taking) system built has a capacity of 149 data points, 120 for thermocouples, 20 for flow, pressure, draft, and so on, and 9 for oxygen analysis. All the data points except those for oxygen analysis are interrogated and the numerical values punched in teletype tape in about 100 sec; the nine oxygen samples require 12 min for reading. Thus, a complete data run requires 13 min and 40 sec. An oxygen-sample tube-cleaning operation prevents repeating the oxygen analysis within 10 min, but this does not interfere with repeating the taking of temperature, pressure, flow, and draft data.



Simplified arrangement of automatic digital-data-collecting system for use in central stations

The basic building block of the system is a device called an analog scanner which consists of a stepping switch, a standard self-balancing potentiometer, and a retransmitting slide-wire. Its function is to convert the primary element or transducer signal to a standard analog signal representing the value of the measured variable. In the system being described, an analog scanner can be connected to any one of 20 thermocouples or transducers through its stepping switch. Temperatures, pressures, flows, and so on, may be intermixed on any given scanner. These analog scanners, which are connected to the control console by a flexible cable, may be located anywhere throughout the boiler convenient to the points to be measured. The object of this arrangement is to minimize the amount of special wiring required for each new installation. The cable connecting the scanner to the control console is prefabricated and equipped with AN-type end connectors.

The system output is paper-tape-punched in teletype code containing the desired data. This tape also containing certain computer commands, namely, the date, time, and test number, is used to transmit the data to the computer via teletype.

DATAK uses its own thermocouples and other transducers, thus not interfering with the normal operation of the boiler. This procedure allows transducer ranges to be set at optimum values for the test rather than accepting the limitations imposed by operating requirements. Because no permanent wiring is required, a relatively small crew can move the equipment into a plant, install it, run the tests, and move out with a minimum of labor and material cost.

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Further Steam-Electric-Generation Expansion in Southern California, by W. L. Chadwick, Mem. ASME, Southern California Edison Company, Los Angeles, Calif. 1957 ASME Semi-Annual Meeting paper No. **57—SA-76** (multilithographed; available to April 1, 1958).

THIS paper presents the background of continuing expansion of steam power in Southern California from 1949 to the present, the expanding requirements of the area served, the location of the new equipment, design trends of the new stations, fuel-supply economics which have influenced station-design criteria, and water and waste-disposal problems.

In this area, the total number of meters added during the six years from 1951 through 1956 was 450,317. The change in system peak was from one million kilowatts in 1945 to two million kilowatts in 1954, then to two and one-half million kilowatts in 1956.

Some aspects of the task of designing and building the steam-electric generation required to meet this growth are

described in this paper. The task has required the completion of one and a quarter million kilowatts and four stations in six years, along with the current design and construction of 800,000 kw in two more stations to be completed in 1958 and 1959.

The steam-electric expansion described is notable because of the following accomplishments and related conditions, each of which is discussed in detail:

1 In spite of the rapid construction program, of the annual increase in general construction cost, and of the increasing use of higher pressures and temperatures, the lowest cost per kilowatt was achieved on the last station completed.

2 Complete construction of a two-unit 312,500-kw station was achieved on one station in twenty-seven months, and for the first unit in nineteen months, from award of an engineering and construction contract to commercial operation. All work was on a one-shift-per day, five-day week basis, and only selected overtime near startup was used.

3 The economy of completely outdoor construction has been repeatedly utilized.

4 Construction of two stations has been completed without railroad connections to the site. Two other stations are being built without such connections. Further, crane capacity has been provided only sufficient to lift the second heaviest piece in each station.

5 With one exception, the stations have been situated at tidewater where three successful submarine cooling-water systems have been built, reaching into deep water directly from a coast exposed to seasonal storms where waves of over 20-ft crests occur at times. These systems also embody successful means of controlling the start and the growth of fouling organisms. Means of fish control are now in development.

6 Use is made in one inland station of water for cooling-tower makeup which has been lifted more than 1600 ft from the Colorado River before it is received at the station.

7 During the period discussed the economics of both power production and of fuel supply have changed markedly.

8 Systems for handling and burning high viscosity fuel oils, both in a plant adjacent to a refinery, and in plants at the far end of long pipelines have been developed.

9 A long system for the disposal of industrial wastes, and of means of modifying such wastes to meet regulatory conditions before discharge, has been developed and constructed.

Studies on Air-Pollution Control by Southern California Edison Company, by A. J. Haagen-Smit, California Institute of Technology, Pasadena, Calif. 1957 ASME Semi-Annual Meeting paper No. **57—SA-59** (multilithographed; available to April 1, 1958).

THE relative contribution of various pollutants found in the Los Angeles area is discussed in this paper. Investigations were made of industrial and municipal fuel-burning installations which were known to contribute to air pollution in other areas. Since only fuel oil, gas, and gasoline are burned in this area, a comparison with eastern cities and their solutions to air-pollution problems was futile.

Processes designed to curtail the emission of oxides of sulfur and nitrogen are described. Power plants in England along the Thames River have removed SO_2 in an effluent process by scrubbing with very large quantities of slightly alkaline river water. In a noneffluent process the gas is scrubbed with a water slurry of lime or chalk.

Other scrubbing processes use ammonia in ammonium sulfite with the intention of producing some usable product in the form of ammonium sulfate, sulfur dioxide, or sulfuric acid. Aqueous ammonia solutions are being used for the removal of sulfur dioxide, and it is claimed that one-state scrubbing will reduce the concentration of SO_2 in flue gas to 800 ppm; a second scrubbing brings the concentration down to 300 ppm. Further descriptions are given of other scrubbing processes.

Removal of contaminants from the air by adsorption processes and chemical conversions are also noted.

Solar Energy

Some Aspects of Solar-Energy Economics, by J. I. Yellott, Mem. ASME, Association for Applied Solar Energy, Phoenix, Ariz. 1957 ASME Semi-Annual Meeting paper No. **57—SA-60** (multilithographed; available to April 1, 1958).

THIS paper discusses the economic possibilities of using solar energy to supplement conventional fuels. Availability of solar energy throughout the United States is reviewed briefly. Methods thus far developed for generating power from solar energy by the use of steam cycles are not encouraging, because of the very large areas of collection surface which are required. Use of solar heat to increase peak-load capacities of steam stations is considered. The most promising application of solar energy is to be found in space heating and cooling. Throughout much of the southwest, space and water heating by solar energy is now competitive with natural gas and is considerably cheaper than bottled gas for off-line locations. When apparatus is developed which can accomplish space cooling as well as heating, solar installations will be cheaper to own and operate than conventional equipment throughout the southern half of the United States.

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Solar Water Heating—Present Practices and Installations, by E. A. Farber, Mem. ASME, University of Florida, Gainesville, Fla. 1957 ASME Semi-Annual Meeting paper No. **57—SA-45** (multilithographed; available to April 1, 1958).

SOLAR water-heating practices and installations currently in use are the subjects of this paper. Solar hot-water systems are quite similar. They all must have a unit exposed to the sun which is able to absorb a considerable portion of the incoming direct and diffuse energy of the sun and convert it to heat; and a tank which stores the water.

Variations in solar hot-water systems are usually in the design of the absorber. There are five different classes of absorber units. The pan-type unit consists of a pan filled with water. The pan, coated with a paint which is highly absorbent, after converting the absorbed energy into heat delivers it to the water. In another type of unit, a sinusoidal tube absorbs solar energy and heats the water inside it. In many areas this tube is placed on a metal sheet and in a "hot box," a box insulated against heat losses. Other types use straight round or oval ducts connected by two headers. The tubes can be horizontal or inclined. The new development of making tubes directly in the sheet by hydraulically expanding the sheet belongs in this same category. The flat-plate type absorber consists, in its simplest form, of two flat plates or thin metal sheets fastened at the edges. A thin layer of water flows between the plates and gives all the advantages of the straight tube closely spaced unit, but is less expensive. Yet another type, the Kawai solar water heater used in Japan, heats the water while it slowly flows from top to bottom through a fabric between two metal plates which are placed in a hot box.

Hot-water storage is expensive. Sufficient capacity for storage must be provided so that hot water can be stored for use when there is no sunshine. For an

average family, in most parts of Florida, a solar hot-water system having a storage capacity of 20 gal of hot water per person per day proves satisfactory. For an average December day in most of Florida a standard absorber will heat a minimum of $1^1/_2$ gal of water per square foot per day from the air temperature to 140 F. Using these data, a solar hot-water system for a family of four should have at least an 80-gal storage tank and a 53-sq ft absorber.

Metal Processing

Shear-Zone Temperature in Metal Cutting and Its Effects on Shear-Flow Stress, by Dimitri Kececioglu, Mem. ASME, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. 1957 ASME Semi-Annual Meeting paper No. **57—SA-70** (multilithographed; to be published in Trans. ASME; available to April 1, 1958).

RELATIONSHIPS are given from which the mean shear-zone temperature in oblique as well as in orthogonal cutting can be calculated. The mean shear-zone temperature, developed when machining SAE 1015, 118 Bhn seamless-steel tubing under a wide range of cutting conditions, is calculated and is found to vary from about 410 to 840 F. The effect of the mean shear-zone temperature on the mean shear-flow stress is studied. In general, the mean shear-flow stress is found to decrease by about 1800 psi for a 100-F increase in the mean shear-zone temperature within the range of 410 and 840 F. This compares with the little or no effect of the mean shear-zone temperature on the mean shear-flow stress reported by Shaw and Finnie, and Chao and Bisacre, respectively. A more comprehensive approach is proposed to establish the effect of the important shear-zone factors on the mean shear-flow stress.

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The Chatter of Lathe Tools Under Orthogonal Cutting Conditions, S. A. Tobias, University of Cambridge, Cambridge, England, and W. Fishwick, University College, Swansea, England. 1957 ASME Semi-Annual Meeting paper No. **57—SA-19** (in type; to be published in Trans. ASME; available to April 1, 1958).

A MATHEMATICAL theory of the chatter of lathe tools is presented. Two types of chatter are distinguished depending on whether the chatter amplitudes fall in the direction of the tool shank or in the direction of the workpiece velocity. The physical causes of chatter taken into consideration are the chip-thickness-variation effect, the penetration effect, and the slope of the cutting-force against cutting-speed curve. The results of the mathematical theory are presented in the form of stability charts. With these, chatter arising during the first revolution of the workpiece and that occurring during subsequent revolutions are discussed. It is shown that the stability of the system is affected by the workpiece velocity, the workpiece material, the geometrical shape of the tool and the tool shank, and so on, and that, under certain conditions, the chip-thickness variation may have a stabilizing influence. The paper deals only with the effect of the various parameters on the stability conditions and is not concerned with the problem of which types of chatter do actually occur in practice.

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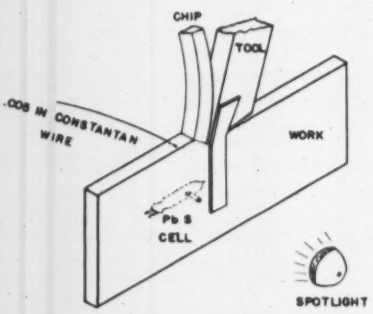
Experimental Measurement of Metal-Cutting Temperature Distributions, by G. S. Reichenbach, Assoc. Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1957 ASME Semi-Annual Meeting paper No. **57—SA-53** (multilithographed; to be published in Trans. ASME; available to April 1, 1958).

Two new methods of measuring cutting temperatures have been evaluated. The first is a radiation technique using a lead-sulfide cell. The cell is arranged to sight through a small hole drilled in the work material sensing radiation from the shear plane and clearance face of the tool. Peak temperatures in these regions have been obtained but shear-plane temperature distributions could not be determined successfully.

The second technique uses a 0.005-in. single wire embedded in the side of a workpiece as a thermocouple. With orthogonal cutting the tool passed beneath the wire so that the wire passed up the tool face still embedded in the chip. By this method it was possible to determine the temperature field throughout the chip and work. These temperature fields have been compared to theoretical predictions and show only fair agreement. The lack of agreement is due partially to the simplifying assumptions of orthogonal cutting and a true geometric shear plane necessary for theoretical solution. The necessity of locating the thermocouple junction on the side of the work introduced errors from side flow of the chip and certain other edge effects. The iteration procedure of Trigger and Chao has been extended to tools of any rake angle and simplified by use of a conducting-paper electrical analog.



Schematic view of embedded thermocouple technique for measurement of metal-cutting temperature distribution

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Analysis of Residual Stress in Ground Surfaces of High-Temperature Alloys, by R. D. Halverstadt, Assoc. Mem. ASME, General Electric Company, Cincinnati, Ohio. 1957 ASME Semi-Annual Meeting paper No. **57—SA-62** (multilithographed; to be published in Trans. ASME; available to April 1, 1958).

RESIDUAL stress caused by grinding high-temperature alloys has proved to be a troublesome problem both from a standpoint of distortion of the parts and from reduced endurance limits. A complete analysis was made which measured the effect of grinding-wheel speed, grinding-wheel hardness, grinding fluid, down feed, and work speed on the residual-stress level in the surface of three alloys used in modern aircraft gas-turbine design. The results of the study show that stresses can be minimized by using lower wheel speeds and down feeds, increasing work speed, and using a sulfurized oil as the grinding fluid.

Lubrication

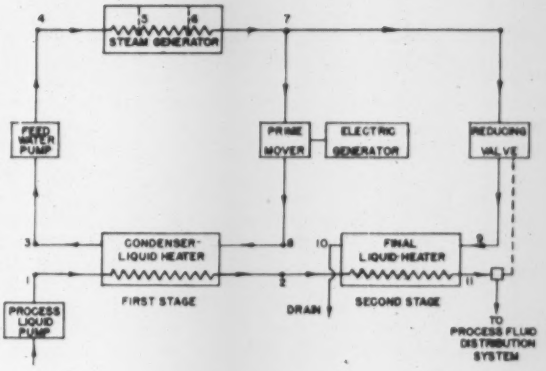
Oil Seals to Provide Positive Lubrication on Large or High-Speed Thrust Bearings, by R. A. Baudry, Mem. ASME, G. E. Peterson, Assoc. Mem. ASME, and G. D. Cooper, Westinghouse Electric Corporation, East Pittsburgh, Pa. 1957 ASME Semi-Annual Meeting paper No. **57—SA-74** (multilithographed; to be published in Trans. ASME; available to April 1, 1958).

VERTICAL water-wheel generators are provided with large thrust bearings the surfaces of which are separated by a hydrodynamic oil film. In order to insure the formation of the required oil film, a continuous and sufficient supply of oil is required.

This paper considers the fact that, on high-speed machines, the oil in the bearing reservoir may become aerated to a

Process Industries

Performance Prediction for a Process Heat-and-Power Complex by Resistance Concept, by C. F. Kayan, Mem. ASME, Columbia University, New York, N. Y. 1957 ASME Semi-Annual Meeting paper No. **57—SA-16** (in type; to be published in Trans. ASME; available to April 1, 1958).

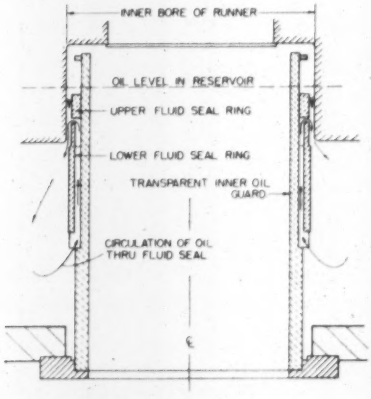


Heat-and-power process-plant equipment arrangement. It may be presumed that the prime mover, such as a steam turbine, exhausts directly to the vapor-condensing fluid heater and thus serves, in effect, as a power-producing "reducing valve."

In process-plant engineering, systems of process-fluid heating combined with power generation are often of such complex character that orthodox analytical methods of mathematical, graphical, and numerical nature prove inadequate. In general, solution of thermal-energy flow processes, particularly under off-design conditions, is fraught with many complications; under these circumstances, recourse to analysis via the resistance concept of energy flow, offers distinct advantages. Furthermore, in terms of the concept which expresses flow as the result of a motivating force acting against resistance, processes may be simulated analytically by electrical flow with its attendant circuitry; that is, by electrical analogy.

In the heat-and-power process plant treated, a prime mover, such as a steam turbine, exhausts directly to a vapor-condensing fluid heater, thus serving, in effect, as a power-producing "reducing valve." In such an arrangement, the performance of the turbine, as to steam consumption and corresponding steam exhaust, is greatly influenced by the heater conditions; conversely, the heater performance is directly dependent on the associated steam-turbine performance. The prediction of over-all performance characteristics of such an integrated complex is one in which the resistance concept is of unique value. Adaptation to simulation via electrical analogy thus introduces another tool for the study of combined process-and-power systems, the demonstration of which is the particular purpose of the present paper.

considerable extent by turbulence at the bore and the periphery of the thrust bearing. Such aeration of the oil may interfere with the formation of the desired oil film. The proper application of laminar fluid seals at the bore and periphery of the thrust-bearing runner, and the maintenance of positive pressures at these seals effectively prevent aeration of the oil in large and high-speed thrust bearings, thus insuring adequate lubrication.


INNER BORE OF RUNNER
OIL LEVEL IN RESERVOIR
UPPER FLUID SEAL RING
LOWER FLUID SEAL RING
TRANSPARENT INNER OIL GUARD
CIRCULATION OF OIL THRU FLUID SEAL

Cross section of transparent inner oil guard with laminar fluid seal rings. The seal ring is supported from the oil guard, and is found to prevent turbulence and aeration of the oil even at high rotational speed.

Influence of Load and Thermal Distortion on the Design of Large Thrust Bearings, by R. A. Baudry, Mem. ASME, and E. C. Kuhn, Assoc. Mem. ASME, Westinghouse Electric Corporation, East Pittsburgh, Pa., and W. W. Wise, Westinghouse Electric Corporation, Philadelphia, Pa. 1957 ASME Semi-Annual Meeting paper No. **57—SA-73** (multilithographed; to be published in Trans. ASME; available to April 1, 1958).

An appreciable part of the available electrical energy is generated by hydroelectric units of the vertical type. The speed and size of these units are selected to obtain the most economical and efficient installation. For many years in this country the trend has been toward machines of larger rating and lower speed.

High-capacity vertical water-wheel generators require large thrust bearings in which the load is carried on a thin hydrodynamic film of oil. Thermal and load distortion of the bearing parts have to be limited to a low value to permit the normal and complete formation of the oil film predicted by the hydrodynamic theory of lubrication. Excessive load and thermal distortion materially affect bearing performance and may result in bearing failure.

This paper describes some design considerations given vertical water-wheel-generator thrust bearings in order to avoid highly concentrated loading during the starting period and to obtain minimum distortion of the pad during operation at normal speed and load. The major considerations are of pressure distribution on thrust-bearing pads with disk-type and multiple-type support; and of pad distortion, due to hydrodynamic pressure of the oil film or resulting from thermal gradients.

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The Prediction of Journal-Bearing Temperatures by the Application of Heat-Transfer Theory and Data, by A. H. Burr, Mem. ASME, and D. Dropkin, Cornell University, Ithaca, N. Y. 1957 ASME Semi-Annual Meeting paper No. **57—SA-89** (multilithographed; available to April 1, 1958).

A sound basis in heat-transfer theory, together with coefficients, has been presented for the predetermination of bearing operating temperatures. The rotating shaft is found to be a major source of heat dissipation. To minimize the cut-and-try nature of the calculations, certain approximations are indicated—uniform temperature throughout the bearing, equal temperatures in bearing and oil film, a central position for the adiabatic plane, and a constant combined convection and radiation coefficient for the shaft.

The initial test results with a bearing of cylindrical shape and effective shaft

length twice the bearing length, justify the approximations and indicate that basic theory may be successfully applied. When additional experimental data become available, it is hoped that charts may be developed for the further simplification of temperature calculations.

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The Effect of Heat Conductance on Slider-Bearing Characteristics, by W. H. Guilinger and E. Saibel, Mem. ASME, Carnegie Institute of Technology Pittsburgh, Pa. 1957 ASME Semi-Annual Meeting paper No. **57—SA-90** (multilithographed; to be published in Trans. ASME; available to April 1, 1958).

THIS paper discusses the problem of the slider bearing when the heat generated in the oil by its internal friction affects the density and viscosity, and when the pressure generated in the oil affects the density and viscosity, and when this heat may be conducted in the fluid and through the bearing and slider surfaces.

Starting from the Navier-Stokes equations, the equation of continuity, and the equation of dissipation, by considering orders of magnitude as is generally done in boundary-layer theory, these equations are reduced to tractable form.

The equations are then put in form for machine calculation, and a method of carrying out the calculations as well as a type of error control are suggested.

Applied Mechanics

Stress-Strain Relations and Vibrations of a Granular Medium, by J. Duffy and R. D. Mindlin, Mem. ASME, Columbia University, New York, N. Y. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-39** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1958).

A DIFFERENTIAL stress-strain relation is derived for a medium composed of a face-centered cubic array of elastic spheres in contact. The stress-strain relation is based on the theory of elastic bodies in contact, and includes the effects of both normal and tangential components of contact forces. A description is given of an experiment performed as a test of the contact theories and the differential stress-strain relation derived from them. The experiment consists of a determination of wave velocities and the accompanying rates of energy dissipation in granular bars composed of face-centered cubic arrays of spheres. Experimental results indicate a close agreement between the theoretical and experimental values of wave velocity. However, as in previous experiments with single contacts, the rate of energy dissipation is found to be proportional to the square of the maximum tangential contact force rather than to the cube, as predicted by the theory for small amplitudes.

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Stresses in a Perforated Strip, Chih-Bing Ling, Aeronautical Research Laboratory, Taichung, Taiwan, China. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-8** (in type; to be published in the *Journal of Applied Mechanics,* available to April 1, 1958).

THIS paper presents an analytic solution of the classical problem dealing with the stresses in an infinite strip having an unsymmetrically located perforating hole.

The solution is applicable to any stress system acting in the strip, which is symmetrical with respect to the line of symmetry of the strip. The required stress function is constructed by using four series of biharmonic functions and a biharmonic integral. The four series of biharmonic functions are formed from a class of periodic harmonic functions specially constructed for the purpose.

The solution can be regarded as a complete solution of the problem in the sense that, unlike the previous solutions by Howland, Stevenson, and Knight for a symmetrically perforated strip, it is valid in the entire strip. Numerical examples are given for the fundamental cases of longitudinal tension and transverse bending.

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The Sector Problem, by G. Horvay, Mem. ASME, and K. L. Hanson, General Electric Research Laboratory, Schenectady, N. Y. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-30** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1958).

ON THE basis of the variational method, approximate solutions

$$f_k(r)h_k(\theta),\ f_k(r)g_k(\theta),\ F_k(\theta)H_k(r),\ F_k(\theta)G_k(r)$$

of the biharmonic equation are established for the circular sector with the following properties: The stress functions f_kh_k create shear tractions on the radial boundaries; the stress functions f_kg_k create normal tractions on the radial boundaries; the stress functions F_kH_k create both shear and normal tractions on the circular boundary, and the stress functions F_kG_k create normal tractions on the circular boundary. The enumerated tractions are the only tractions which these function sets create on the various boundaries of the sector. The factors $f_k(r)$ constitute a complete set of orthonormal polynomials in r into which (more exactly, into the derivatives of which) self-equilibrating normal or shear tractions applied to the radial boundaries of the sector may be expanded; the factors $F_k(\theta)$ constitute a complete set of orthonormal polynomials in θ into which shear tractions applied to the circular boundary of the sector may be expanded; and the functions $F_k'' + F_k$ constitute a complete set of nonorthogonal polynomials into which normal tractions applied to the circular boundary of the sector may be expanded. Function tables, to facilitate the use of the stress functions, are also presented.

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The Elastic Coefficients of the Theory of Consolidation, by M. A. Biot, Mem. ASME, and D. G. Willis, Shell Development Company, New York, N. Y. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-44** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1958).

THE theory of the deformation of a porous elastic solid containing a compressible fluid has been established by Biot.

In this paper methods of measurement are described for the determination of the elastic coefficients of the theory. The physical interpretation of the coefficients in various alternate forms is also discussed. Any combination of measurements which is sufficient to fix the properties of the system may be used to determine the coefficients. For an isotropic system, in which there are four coefficients, the four measurements of shear modulus, jacketed and unjacketed compressibility, and coefficient of fluid content, together with a measurement of porosity appear to be the most convenient. The porosity is not required if the variables and coefficients are expressed in the proper way. The coefficient of fluid content is a measure of the volume of fluid entering the pores of a solid sample during an unjacketed compressibility test. The stress-strain relations may be expressed in terms of the stresses and strains produced during the various measurements, to give four expressions relating the measured coefficients to the original coefficients of the consolidation theory. The same method is easily extended to cases of anisotropy. The theory is directly applicable to linear systems but also may be applied to incre-

mental variations in nonlinear systems provided the stresses are defined properly.

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On the Principle of Haar and von Karman in Statically Determinate Problems of Plasticity, by Leo Finzi, Polytechnic of Milan, Milan, Italy. 1957 ASME Applied Mechanics Summer Conference Paper No. **57—APM-6** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1958).

In 1909 Haar and von Karman stipulated a variational principle as the basis of the theory of plasticity. This principle is an extension of the principle of least work to elastic-plastic bodies; it involves not only the strain energy of the elastic part of the body, but also an elastic strain energy attributed to the plastic part.

The latter strain energy is defined as the energy that would be recovered on removing the loads and relieving all internal bonds connecting the particles of the body. Accordingly, the principle of Haar and von Karman is not suitable for a generic elastic-plastic body but only for the bodies with special stress-strain relations; for instance, the relation of Hencky.

This paper is concerned with problems of contained plastic deformation, particularly the completely statically determinate problems of plasticity. It is shown that, for these problems, a variational formula, similar to the one expressing the principle of Haar and von Karman, holds independently of the plastic stress-strain relations and the yield condition. The fact is emphasized that in these problems the essential element in the variational formulation is the elastic region surrounding the plastic one, so that the latter appears only inasmuch as its presence allows the elastic-region variations of field besides variations of energy density. These ideas are explained by way of a simple example.

ASME Transactions

The July, 1957, issue of the Transactions of the ASME (available at $1 per copy to members; $1.50 to nonmembers), contains the following technical papers:

The Application of a New Structural Index to Compare Titanium Alloys With Other Materials in Airframe Structures, by L. R. Jackson and S. A. Gordon. (56—AV-10)

Optimum Stresses of Structural Elements at Elevated Temperatures, by Arthur Schnitt, M. A. Brull, and H. S. Wolko. (56—AV-11)

Thermostructural Efficiencies of Compression Elements and Materials, by George Gerard. (56—AV-12)

Weight-Efficiency Analysis of Thin-Wing Construction, by R. A. Anderson. (56—AV-13)

Design Criteria for Heated Aircraft Structures, by Robert Goldin. (56—AV-14)

Discussion on Safety-Factor Requirements for Supersonic Aircraft Structures, by G. M. Goldman. (56—AV-18)

Some Structural Penalties Associated With Thermal Flight, by J. W. Mar and L. A. Schmit. (56—AV-9)

Aircraft Structural Testing Techniques at Elevated Temperatures, by R. C. Brouns and R. B. Baird. (56—AV-15)

Some NACA Research on Effect of Transient Heating on Aircraft Structures, by J. E. Duberg. (56—AV-16)

Utilization of Solar Furnaces in High-Temperature Research, by Pol Duwez. (56—AV-17)

Description and Prediction of Human Response to Aircraft Thermal Environments, by Craig L. Taylor. (56—AV-3)

Oronite High Temperature Hydraulic Fluids 8200 and 8515, by N. W. Furby, R. L. Peeler, and R. I. Stirton. (56—AV-22)

Mass Flowmeter for In-Flight Refueling, by C. F. Taylor. (56—AV-20)

Noise, Vibration, and Measurement Problems, Resulting From Fluid-Flow Disturbances, by R. L. Solnick and R. H. Bishop

Effect of the Volute on Performance of a Centrifugal-Pump Impeller, by R. D. Bowerman and A. J. Acosta. (56—SA-45)

Pressure Drop and Flow Characteristics of Short Capillary Tubes at Low Reynolds Numbers, by Frank Kreith and Raymond Eisenstadt. (56—SA-15)

Orifice-Metering Coefficients and Pipe Friction Factors for the Turbulent Flow of Lead-Bismuth Eutectic, by H. A. Johnson, J. P. Hartnett, W. J. Clabaugh, and L. Fried. (56—SA-16)

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Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

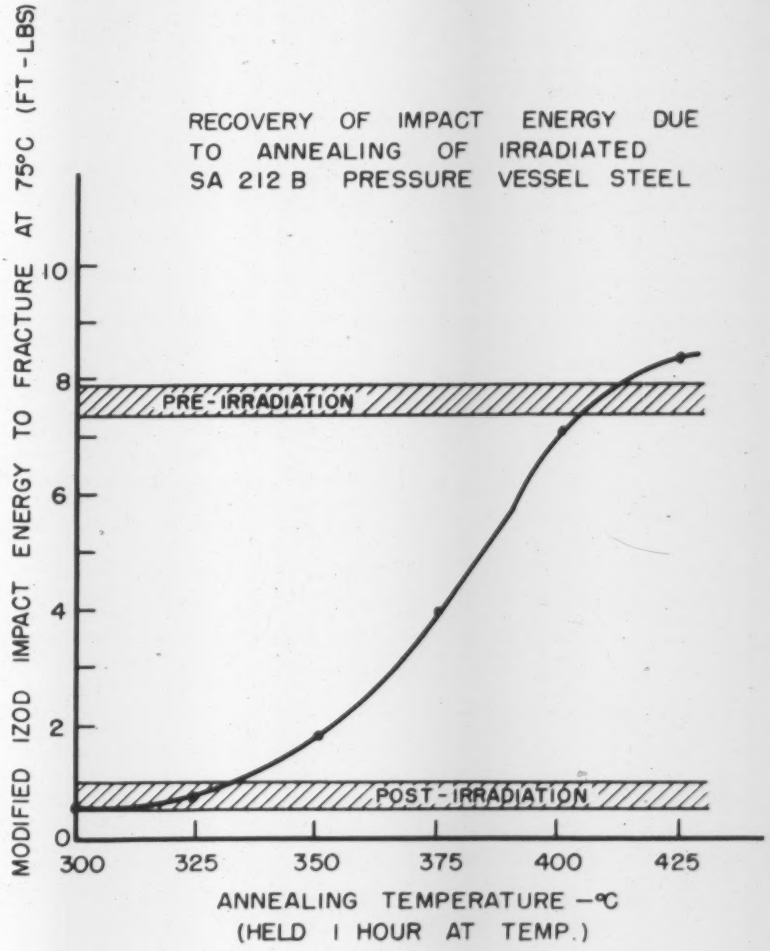
Neutron Radiation

Comment by M. L. Bleiberg[1]

ALTHOUGH investigations into the effects of neutron bombardment upon the properties of steel are of relatively recent origin, it has been recognized that quantitative analysis of these effects has been complicated by the influence of temperature on the neutron-induced property changes. The author of this paper[2] has added a noteworthy contribution to the growing knowledge of this temperature dependency.

In order to interpret the elevated temperature effect on the neutron-induced mechanical property changes in Type A-302 steel, the author was required to make several assumptions. One of these (number 2) was that "the change in impact and tensile properties is directly proportional to the integrated flux in the range of 1×10^{18} to 1×10^{19} nvt." This assumption is certainly reasonable and is believed to be correct. However, caution must be exercised in extending this assumption to higher exposures and in particular to much lower exposures. The reason for this may be seen by examination of the available experimental data. Wilson and Berggren (1)[3] showed that in Type SA 212 B steel there was a greater change in both impact and tensile properties after an exposure of 1×10^{20} nvt than after an exposure of 1×10^{19} nvt. Bleiberg (2) has shown in Type SA 212 B steel that the maximum ductile impact strength decreased and the ductile-to-brittle transition temperature increased with exposure in the range of 3×10^{19} to about 1.5×10^{20} nvt. However, no further changes in these properties were found between exposures of 1.5×10^{20} and 2.1×10^{20} nvt, which would indicate a saturation effect. Also, Meyer (3) has shown that deuteron bombardment of SAE 1019 steel, irradiated at −150 C, showed no change in impact strength after an exposure of 3.7×10^{17} particles per second, but after an exposure of 6.7×10^{17} particles per second, severe changes in this property were noted. Assuming that the nature of the damage produced by deuterons is similar to that produced by neutrons (creation of interstitial atoms and vacant lattice sites), then one could conclude that no change in impact strength in steel would be noted below exposures of about 4×10^{17} nvt, and that those changes occurring at higher exposures would saturate at about 1.5×10^{20} nvt. It should also be pointed out that no experimental evidence is yet available to show that these property changes are a function of integrated flux rather than flux intensity. That is, the question of whether long-time exposure at low flux would produce property changes identical with those produced by a similar integrated flux exposure obtained by short-time exposure at high flux, all other factors being equal, has not been answered.

The lack of observable effects on the impact strength of Type A-302 steel at elevated temperatures is consistent with



[1] Senior Engineer, Bettis Plant, Westinghouse Electric Corporation, Pittsburgh, Pa.

[2] "Neutron Radiation Effects on Tensile and Impact Properties of ASTM-A302 B Steel," by E. E. Baldwin, MECHANICAL ENGINEERING, vol. 79, March, 1957, pp. 261–265.

[3] Numbers in parentheses refer to references at the end of the comment.

a postirradiation heat-treatment study on Type SA 212 B steel by Bleiberg (2). These results, shown in the figure, were obtained on specimens irradiated to about 2×10^{20} nvt at pile ambient temperature ($\sim$ 100 C) and then heat treated at temperatures of 300 to 425 C for one hour. These specimens were then tested at 75 C at which temperature the unirradiated specimens exhibited ductile fracture, whereas the irradiated specimens were brittle. It is evident that recovery of notch toughness from radiation damage in this material after one hour heat-treatment starts at 350 C, increases with increasing temperatures, and is fully realized at 425 C. By assuming, as the author does, that Type A-302 steel behaves in the same manner as Type SA 212 B steel, then the data in the figure show that at the upper temperature of irradiation (700 F, 371 C) of the Type A-302 steel after a one-hour heat treatment, approximately 50 per cent of the radiation damage is "annealed" out. It has been shown in annealing studies of irradiated zirconium (by using electrical resistance measurements) that the point defects caused by neutron bombardment anneal out at elevated temperatures as a function of the logarithm of time (4), and presumably this is also true in steels. Thus one would expect that 20 days at 700 F during neutron bombardment would certainly be sufficient to anneal these defects so that no appreciable change in mechanical properties in the steel specimens would result. Therefore the author's conclusions on the effects of irradiation at elevated temperatures are in agreement with the information obtained at Bettis Plant and with other published data.

References

1 "Effect of Neutron Irradiation in Steel," by J. C. Wilson and R. G. Berggren. Paper presented at ASTM annual meeting, June 26, 1955.

2 "Effect of Neutron Bombardment Upon the Properties of ASTM Type SA 212 B Steel," by M. L. Bleiberg. Bettis Plant Technical Paper, WAPD-T-206, Oct. 12, 1955.

3 "Influence of Deuteron Bombardment and Strain Hardening on Notch Sensitivity of Mild Steel," by R. A. Meyer, *Journal of Applied Physics*, vol. 25, no. 11, p. 1369, November, 1954.

4 AEC Bettis Plant Report, WAPD-107, by M. L. Bleiberg and L. S. Castleman, April 23, 1954.

Author's Closure

The author wishes to thank Mr. Bleiberg for his careful review and analysis of the data reported. As indicated, the fast neutron exposure received by the test specimens was calculated on the basis of nominal neutron flux in the irradiation facility. If flux monitors were used to measure the fast neutron flux received by the test specimens, it is felt that the value would have been lower than that reported (3.7×10^{18} nvt). If this were the case, it would offer more support to the test results reported and the conclusions drawn therefrom.

E. E. Baldwin.[4]

Atomic Energy in Testing

Comment by Ray McBrian[5]

THIS paper[6] is excellently prepared and reviews the possibilities in the applications of the testing of materials.

Each railroad in our opinion should fully explore as to their own possible use of these methods of inspections. We have for many years utilized a cobalt-60 source to check the welded rail in our 6.2 mile long Moffat Tunnel, as well as to check welds in the ventilating fan.

We have had activated, at the Brookhaven National Laboratories, a wrist pin from an Electro Motive Diesel Electric unit for the study of wear problems.

Our experience in this field for use on moving diesel units has been that the background level of radio activity as picked up in the air stream and which lodges in the diesel air filters and in the crankcase lubricating oil, presents a problem which is not present when such tests are made at a static location. Metering and gaging are major fields of application in the railroad industry in which isotopes can be successfully applied.

Tracer elements of isotopes can be used in fuels and lubricants to determine the actual reactions which take place during combustion and in lubrication. Isotopes of sulfur, nitrogen, and additive metals can all be so applied for such studies.

Railroad personnel can be trained for the various applications and monitoring, or competent laboratories in the atomic-energy field offer such services at nominal costs.

[4] Engineer, Knolls Atomic Power Laboratory, General Electric Company, Schenectady, N. Y.

[5] Director of Research, Denver & Rio Grande Western Railroad Company, Denver, Colo. Mem. ASME.

[6] "The Use of Atomic Energy in the Testing of Materials," by W. M. Keller, MECHANICAL ENGINEERING, vol. 79, March, 1957, pp. 258–260, condensed from ASME Paper No. 56—A-81.

Developments in Plastics Engineering

Comment by G. B. Thayer[7]

IN GENERAL, this paper[8] presents a review of information concerning an adequate range of subjects of interest specially to mechanical engineers. More topics could have been discussed at the hazard of loss of emphasis of the most interesting and significant developments. As a matter of experience, this hazard is real. If professional behavior could allow envy to sneak into a discussion of a technical paper, this discussion would include a confession of the vice on the part of this discusser who faced the innumerable decisions concerning which literature to include and which to omit only a few years back. The 1951 review might have been better if it had combined brevity with good judgment in selecting the most significant developments of interest to mechanical engineers as Mr. Maxwell has.

The review of high lights of economic aspects of the plastics industry at the beginning, and of society activities at the end, provides some nontechnical information of lasting interest, which is well worth the time spent by mechanical engineers in reading.

It will be interesting to see the reaction of librarians who receive requests for copies of the literature cited in the bibliography. They should be perfectly able to find the material, but not by title of the article. This is not a serious fault, though the abbreviation is somewhat unusual and subject to considerable criticism on the part of people who like to be precise. Librarians also like to know how many pages there are in an article, mostly because they all must have, at one time or another, ordered photo copies of something listed by the page of beginning which came back photographed about as thick a package as the Manhattan telephone directory. Once can ruin the budget of the library. This bibliography does not contain any reference of such size, with the possible exception of the U. S. Tariff Commission report which this discusser has not seen and hence cannot be sure about its extent.

This paper is easy reading and difficult to put aside once started. Papers of this nature, for reference, need not be easy reading, but it helps, and we are not

[7] Plastics Technical Service, The Dow Chemical Company, Midland, Mich. Mem. ASME.

[8] "Developments in Plastics Engineering . . . 1955–1956," by Bryce Maxwell, MECHANICAL ENGINEERING, vol. 79, February, 1957, pp. 161–164, condensed from ASME Paper No. 56—A-183.

against adding an occasional pleasant interlude to our ordinary routine of plain hard work in keeping up with the latest developments.

Comment by A. G. H. Dietz[9]

With the rapid expansion of engineering uses of plastics it becomes increasingly difficult to keep abreast of developments. The author has done well to review and summarize the major trends occurring in 1955–1956. Engineers generally, particularly those not dealing directly with plastics, should find this review helpful. As is usual in a review such as this, one of the most valuable features is the bibliography.

The review points up, by implication as well as by direct reference, the continuing activity in determination of engineering properties. Among the most pressing are the long-time mechanical behavior under stress, the long-time effect of environment including weathering, and better engineering design procedures that take into account the properties of plastics.

Author's Closure

Mr. Thayer's point about the form of designating references is well taken. This author is guilty of taking the easiest approach by not presenting the number of pages in the articles sighted. To estimate the length of the articles is sometimes rather difficult since, in the journals sighted, advertisements and other material often are interspersed with the technical papers.

Professor Dietz brings up a subject (long-time mechanical behavior) which is of primary current importance. This subject was not discussed at length in the paper since it is the author's feeling that much work must be done before we can reach concrete conclusions on this subject.

Bryce Maxwell.[10]

[9] Professor, Civil-Engineering Department, Massachusetts Institute of Technology, Cambridge, Mass. Mem. ASME.

[10] Princeton University, Plastics Laboratory, Princeton, N. J.

Reviews of Books

And Notes on Books Received in Engineering Societies Library

Air Pollution and Industrial Hygiene

Air Pollution Handbook. Edited by Paul L. Magill, Francis R. Holden, Charles Ackley, with Frederick G. Sawyer as editorial consultant. McGraw-Hill Book Company, Inc., New York, N. Y. 1956. Cloth, 5¾ × 9 in., figs, tables, references; index, xi and 15 chapters, each individually numbered, $15.

Encyclopedia of Instrumentation for Industrial Hygiene. Technical editors: Charles D. Yaffee, Dohrman H. Byers, and Andrew D. Hosey. Institute of Industrial Health, University of Michigan, Ann Arbor, Mich., 1956. Cloth, 9 × 12 in., illus., xvii and 1243 pp., $35.

Reviewed by F. S. Mallette[1]

The Air Pollution Handbook is divided into 14 sections of which sections 1 and 2 state the problem, sections 3 through 6 pertain to the science of air pollution, sections 7 through 9 discuss the effects, and sections 10 through 14 cover various correct air techniques.

Some 31 contributors played a part in the creation of the book. For this reason, there is considerable duplication—a problem always facing editors in a book made up in this way. Some of the contributions could have been cut extensively or even omitted because of the coverage by other authors.

On the whole, however, the book presents a tremendous amount of useful material, so much so that a small type-size was employed in order to reduce the size of the book. Only the excellent paper on which it is printed saves it from being difficult to read.

There are extensive bibliographies at the end of each section, a table of conversion factors, and an excellent index. The book makes a useful addition to the air-pollution library.

The encyclopedia merits its title. Based on a symposium on instrumentation for industrial hygiene, the book describes instruments which may also be used in the study of air pollution. As in the latter problem, "...the heart of modern industrial hygiene is measurement" and, by the same token, identification also.

Intended for desk use only, this large volume is divided into seven sections: (*a*) Instruments for studying industrial environments; (*b*) laboratory instruments for specific applications; (*c*) instruments for the evaluation of atmospheric pollution and for meteorological studies; (*d*) instruments for measuring gas velocities and for metering; (*e*) instruments for measuring sound and vibrations; (*f*) instruments for measuring ionizing radiations; and (*g*) instruments for measuring ultraviolet, visible, and infrared energy.

There is an excellent and extensive appendix containing much useful information, a subject index, and a name index.

Profusely illustrated, the encyclopedia is on good paper with readable type. It is highly recommended.

[1] Executive secretary, ASME Committee on Air-Pollution Controls. New York, N. Y. Mem. ASME.

Books Received in Library

Théorie et Technique de la Radiocristallographie. By A. Guinier. Second edition, 1956, Dunod, Paris, France. 736 p., 6¼ × 9¾ in., bound. Fr. Frs. 9500. An extensive and comprehensive treatise on x-ray diffraction theory, experimental methods of investigation, and applications. The major part of the book is devoted to normal crystalline solids and powders and single crystals, but imperfect crystals and amorphous substances are also dealt with. X-ray apparatus, the general properties of x rays, and the fundamentals of crystallography are covered in the early chapters, and a discussion of Fourier transforms is appended. Applications to the fields of metallography, the physics of solids, and other special adaptations are of particular interest to engineers.

Veröffentlichungen des Deutschen Stahlbau-Verbandes. No. 9, No. 10, No. 11. 1955, 1956, 1956, Stahlbau-Verlag, Cologne, Germany. 114 p., 88 p., 88 p., 6¾ × 9½

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

in., paper. DM 18.00, DM 10.50, DM 9.60. Three more publications in a series issued by the German institute for steel construction.

No. 9 Static and dynamic analysis of suspension bridges with the use of Green's functions and integral equations; particularly with regard to aerodynamic stability.

No. 10 Four papers dealing with various aspects of structural steel fabrication and erection, plus one brief discussion of the possible relation of atomic energy to the manufacture and use of steel.

No. 11 Three technical articles on strength of materials theory and research and on steel construction in bridge building; also a nontechnical article on traffic problems in Germany.

WING THEORY. By A. Robinson and J. A. Laurmann. 1956, Cambridge University Press, New York, N. Y. 569 p., 6 × 10 in., bound. $13.50. Devoted to the investigation and calculation of the aerodynamic forces which act on a wing or system of wings, this book for advanced students and aeronautical engineers contains comprehensive discussions of the theory of airfoils in two-dimensional steady flow, three-dimensional steady flow, compressible flow, and in unsteady motion. The fundamentals of hydrodynamics required for an understanding of these discussions are covered in the opening chapter.

ASME Boiler and Pressure Vessel Code

Interpretations

THE Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting March 1, 1957, and approved by the Board on April 22, 1957.)

Case No. 1238 (*Special Ruling*)

(Intermediate Containment Vessels)

Inquiry: May intermediate containment vessels, such as shield tanks, within the outer or final containment vessel as defined in Case No. 1224 for nuclear reactor installations, be built under Section VIII, Code for Unfired Pressure Vessels, without the stress-relieving specified in Par. UW-2(a)?

Reply: It is the opinion of the Committee that intermediate containment vessels fall under the category of those containing lethal substances, but still may be built without the stress-relieving required in Par. UW-2(a), provided the requirements of Case No. 1226, omitting Par. 1, are met.

Case No. 1239

(*Interpretation of Par. UG-84(d)*

(Impact Test Requirements)

Inquiry: Where impact tests are required for vessels in service below −100 F, the requirements of Par. UG-84(d) as to subcooling impact specimens 5 to 10 F below test temperature respectively for minimum operating temperatures below −100 and −200 F may constitute an uneconomic burden if refrigerants are not commercially available for subcooling the test pieces. Approval is, therefore, requested for performing impact tests with specimens cooled to the intended service temperatures.

Reply: It is the opinion of the Committee that the essential requirements of Par. UG-84(d) for service below −100 F are met with the test specimens cooled to the service temperature, provided the transfer of specimens from the cooling bath to the full accomplishment of testing occupies not more than the interval specified in Par. UG-84(d), and the coolant is volatile under ambient conditions with continued cooling by evaporation during the transfer interval. Also, the material undergoing tests must exhibit an essentially flat slope of impact value to temperature in the range of temperature which may be encountered during the interval of testing.

Case No. 1122-5

(*Reopened*) (*Special Ruling*)

Revise the footnote at the end of the table to read:

Due to the relatively low yield strength of this material, the higher stress values at temperatures from 200 F through 1050 F were established to permit the use of this material where slightly greater deformation is acceptable. The stress values within the above range exceed 62½ per cent, but do not exceed 90 per cent of the yield strength at temperature. These stress values are not recommended for the design of flanges or piping.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

AS NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Power Boilers, 1956

PAR. P-249 Delete reference "(See Fig. P-32)" at the end of the first paragraph.

TABLE P-7 Revise footnote (7) to read:

[7] Due to the relatively low yield strength of this material, the higher stress values at temperatures from 200 F through 1050 F were established to permit the use of this material where slightly greater deformation is acceptable. The stress values within the above range exceed 62½ per cent, but do not exceed 90 per cent of the yield strength at temperature. These stress values are not

recommended for the design of flanges or piping.

TABLE P-7 Add the accompanying stress values for Type 348 material.

Material Specifications, 1956

SA-350 Specification for Forged or Rolled Carbon and Alloy Steel Flanges, Forged Fittings and Valves and Parts for Low-Temperature Service. Revise to add an Advisory Appendix which explains the limited value of impact testing. (Note: This appendix is available from the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th St., New York 18, N. Y.)

Unfired Pressure Vessels, 1956

Par. UG-11 Revise to read:

UG-11 Miscellaneous Pressure Parts Prefabricated or preformed pressure parts for unfired pressure vessels which are subject to allowable working stresses due to internal or external pressure in the vessel and which are furnished by other than the shop of the manufacturer responsible for the completed vessel shall conform to all applicable requirements of the Code as related to a completed vessel, including inspection in the shop of the parts manufacturer and the furnishing of partial data reports as provided for in UG-120(b) except as permitted in (a), (b), and (c).

(a) Cast, Forged, Rolled, or Die-Formed Standard Pressure Parts

(1) Pressure parts such as pipe fittings, valves, flanges, nozzles, welding necks, welding caps, manhole frames and covers that are wholly formed by casting, forging, rolling, or die forming shall not require inspection, mill test reports, or partial data reports, however, they shall be made of materials permitted under Section VIII of the Code or in an accepted standard (such as ASA) covering the particular type of pressure part. Such parts shall be marked with the name or trademark of the manufacturer and such other markings as are required by the several standards. Such markings shall be considered as the manufacturer's certification that the product complies with the material specifications and standards indicated and is

STRESS VALUES TO BE ADDED TO TABLE UHA-23

Material and Specification Number	Grade	Type	Nominal Composition	Specified Min. Tensile	Notes	For Metal Temperatures Not Exceeding Deg F: −20 to 100	200	300	400	500	600
PIPES & TUBES											
SA-213	TP348		18 Cr-10 Ni-Cb	75000		18750	18750	17000	15800	15200	14900
SA-312	TP348		18 Cr-10 Ni-Cb	75000		18750	18750	17000	15800	15200	14900
SA-376	TP348		18 Cr-10 Ni-Cb	75000		18750	18750	17000	15800	15200	14900
WELDED											
SA-249	TP348		18 Cr-10 Ni-Cb	75000	4	16000	16000	14450	13400	12900	12700
SA-312	TP348		18 Cr-10 Ni-Cb	75000	4	16000	16000	14450	13400	12900	12700
FORGINGS											
SA-182	F348		18 Cr-8 Ni-Cb	75000		18750	18750	17000	15800	15200	14900

For Metal Temperatures Not Exceeding Deg F: 650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500
																PIPES & TUBES	
14850	14800	14700	14550	14300	14100	13850	13500	13100	12500	8000	5000	3600	2700	2000	1550	1200	1000
14850	14800	14700	14550	14300	14100	13850	13500	13100	12500	8000	5000	3600	2700	2000	1550	1200	1000
14850	14800	14700	14550	14300	14100	13850	13500	13100	12500	8000	5000	3600	2700	2000	1550	1200	1000
																WELDED	
12650	12600	12500	12350	12150	12000	11800	11500	11100	10600	6800	4250	3050	2300	1700	1300	1000	850
12650	12600	12500	12350	12150	12000	11800	11500	11100	10600	6800	4250	3050	2300	1700	1300	1000	850
																FORGINGS	
14850	14800	14700	14550	14300	14100	13850	13500	13100	12500	8000	5000	3600	2700	2000	1550	1200	1000

STRESS VALUES TO BE ADDED TO TABLE P-7

Material and Specification Number	Grade	Nominal Composition	Spec. Min. Tens.	Notes	−20 to 100	200	300	400	500	600	650	700
PIPES & TUBES												
SA-213	TP348	18 Cr-10 Ni-Cb	75000		18750	18750	17000	15800	15200	14900	14850	14800
SA-312	TP348	18 Cr-10 Ni-Cb	75000		18750	18750	17000	15800	15200	14900	14850	14800
SA-376	TP348	18 Cr-10 Ni-Cb	75000		18750	18750	17000	15800	15200	14900	14850	14800
WELDED												
SA-249	TP348	18 Cr-10 Ni-Cb	75000	8	15950	15950	14450	13450	12900	12650	12600	12550
FORGINGS												
Alloy Steel												
SA-182	F348	18 Cr-8 Ni-Cb	75000		18750	18750	17000	15800	15200	14900	14850	14800

For Metal Temperatures Not Exceeding Deg F: 750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500
														PIPES & TUBES	
14700	14550	14300	14100	13850	13500	13100	10300	7600	5000	3300	2200	1500	1200	900	750
14700	14550	14300	14100	13850	13500	13100	10300	7600	5000	3300	2200	1500	1200	900	750
14700	14550	14300	14100	13850	13500	13100	10300	7600	5000	3300	2200	1500	1200	900	750
														WELDED	
12500	12350	12150	12000	11750	11500	11150	8750	6450	4250	2800	1850	1300	1000	750	650
														FORGINGS	
14700	14550	14300	14100	13850	13500	13100	10300	7600	5000	3300	2200	1500	1200	900	750

suitable for service at the rating indicated. The intent of the paragraph will have been met, if, in lieu of the detailed marking on the part itself, the parts described herein have been marked in any permanent or temporary manner that will serve to identify the part with the manufacturer's written listing of the particular items and such listings are available for examination by the Inspector.

(2) Parts of small size falling within this category for which it is difficult or impossible to obtain identified material or which may be stocked and for which mill test reports or certificates cannot be economically obtained and are not customarily furnished, and which do not appreciably affect the safety of the vessel, may be used for relatively unimportant parts or parts stressed to not more than fifty per cent of the stress value permitted by the Code provided they are suitable for the purpose intended and meet the approval of the inspector (See (1) and Par. UG-6(d).) The manufacturer of the completed vessel shall satisfy himself that the part is suitable for the design conditions specified for the completed vessel.

(b) Cast, Forged, Rolled, or Die-Formed Non-Standard Pressure Parts Pressure parts such as shells, heads, removable doors, and pipe coils that are wholly formed by casting, forging, rolling, or die forming may be supplied basically as materials. All such parts shall be made of materials permitted under Section VIII of the Code and the manufacturer of the part shall furnish mill test reports or other acceptable evidence to that effect. Such parts shall be marked with the name or trademark of the manufacturer and with such other markings as will serve to identify the particular parts with accompanying material identification. The manufacturer of the completed vessel shall satisfy himself that the part is suitable for the design conditions specified for the completed vessel.

(c) Welded Standard Pressure Parts for Use Other Than the Shell of a Vessel[1]

Pressure parts such as pipe fittings, nozzles, welding necks, welding caps, valves, and flanges that are fabricated by one of the welding processes recognized by the Code shall not require inspection, mill test reports, or partial data reports provided:

(1) All such parts are made of materials permitted under Section VIII of the Code or in an accepted standard (such as ASA).

(2) If arc or gas welded, the welding complies with Pars. UW-26 to UW-40, incl.

Such parts shall be marked with the name or trademark of the manufacturer and with such other markings as will serve to identify the materials of which the parts are made. Such markings shall be considered as the manufacturer's certification that the product complies with (1). A statement by the parts manufacturer that all welding complies with Code requirements shall be accepted as evidence that the product complies with (2).

(3) If radiography or heat treatment is required by Pars. UW-10 and UW-11, it may be performed either in the plant of the parts manufacturer or in the plant of the manufacturer of the completed vessel.

If the radiographing is done in the plant of the parts manufacturer, the completed radiographs, properly identified with the respective parts, shall be available to the authorized inspector. If the radiographs are examined in the plant of the parts manufacturer, parts data sheets shall be executed and forwarded to the vessel manufacturer.

(4) If heat treatment is performed at the plant of the parts manufacturer, a statement by the manufacturer that such treatment was performed shall be accepted as evidence of compliance with applicable Code paragraphs. The manufacturer of the completed vessel shall satisfy himself that the part is suitable for the design conditions specified for the completed vessel.

PAR. UW-15(c) Delete the last sentence and add the following: "These telltale holes may be left open or may be plugged when the vessel is in service. If the holes are plugged, the plugging material used shall not be capable of sustaining pressure between the reinforcing plate and the vessel wall."

PAR. UCL-34(b) Revise the sixth line to read: ". . . . . provided the cladding or lining joints are welded with austenitic stainless steel electrodes or a non-air-hardening nickel-chromium-iron electrode and the composition . . . . ."

PAR. UCL-36(b) Revise the first and last sentence to add the words ". . . . . or a non-air-hardening nickel-chromium-iron electrode" after the words "austenitic chromium-nickel-steel electrodes."

PAR. UHA-32(c) Revise to read:

(c) Vessels constructed of materials conforming to Type 405 welded with electrodes that produce an austenitic chromium-nickel alloy steel weld deposit, or a non-air-hardening nickel chromium-iron deposit, are required to be stress-relieved only when required by Par. UW-10.

PAR. UHA-33(b) Revise the second sentence to read:

Vessels constructed of Type 405 material or of Type 410 with carbon content not to exceed 0.08 per cent, welded with electrodes that produce an austenitic chromium-nickel weld deposit or a non-air-hardening nickel chromium-iron deposit shall be radiographed when the plate thickness at the welded joint exceeds $1^1/_2$."

TABLE UHA-23 Revise footnote (1) to read:

[1] Due to the relatively low yield strength of this material, the higher stress values at temperatures from 200 through 1050 F were established to permit the use of this material where slightly greater deformation is acceptable. The stress values within the above range exceed $62^1/_2$ per cent, but do not exceed 90 per cent of the yield strength at temperature. These stress values are not recommended for the design of flanges or piping.

TABLE UHA-23 Add the accompanying stress values for Type 348 material.

[1] Fusion welded pipe for use as the shell of a vessel shall be subject to the same requirements as a shell fabricated from plate, including inspection at the point of manufacture and partial data reports.

Welding Qualifications, 1956

TABLE Q-11.1 Under P-Number 8, add the following Material Specification, Psi Minimum Tensile and Type of Material:

Material Specification	Psi Minimum Tensile	Type of Material
SA-182, Grade F348	75,000	Alloy Pipe Flanges (18 Cr-8 Ni)
SA-213, Grade TP348	75,000	AISI 348 Welded Alloy Steel Tubes
SA-249, Grade TP348	75,000	AISI 348 Welded Alloy Steel Tubes
SA-312, Grade TP348	75,000	Alloy Pipe (18 Cr-10 Ni)
SA-376, Grade TP348	75,000	AISI Seamless Alloy Steel Tubes

Under Type of Material for SA-312, Grade 347, revise (18 Cr-8 Ni) to read (18 Cr-10 Ni).

TABLE Q-11.3 Under Weld Metal Analysis for Anal. No. 7, add AISI Type 348.

Roundup

Of Current Engineering Events, News, and Comment

E. S. Newman, *News Editor*

EIC Reports Large Attendance at 71st Annual Meeting in Banff

ASME joins EIC in presenting petroleum papers

The seventy-first annual meeting of The Engineering Institute of Canada at Banff Springs Hotel, June 12–14, created two records: It was the largest meeting of engineers ever held in Canada west of Toronto, and the largest professional meeting ever held in Banff Springs Hotel. Total registration was 1058.

Early on Monday morning "Operation Banff" commenced to function. On Monday there were conferences of officers, councilors, committeemen, and all arrangements were completed.

On the morning of the eleventh the student delegates met. At the same time the Branch officers and the university engineering faculty members opened their meetings and the annual meeting of Council was convened. All these meetings aroused great interest and provoked excellent discussion and conclusions. After a luncheon the meetings resumed their deliberations.

The President's reception at 7:00 p.m. followed by dinner was held and several guests from the United States and Scotland attended.

General Meeting

Wednesday morning, June 12, the annual general meeting of the Institute was opened by EIC President McKillop. It was well that it had been arranged for this meeting to be held in the ballroom of the hotel as the attendance of members constituted another record in EIC history. The advance printing and distribution of the Annual Report again proved to be a great asset. It facilitated the presentation of reports and provided time for questions and answers without the necessity of running into "overtime." At 12:00 o'clock the meeting adjourned for refreshments and a pleasant, informal luncheon under the chairmanship of annual meeting committee chairman, W. A. Smith of Calgary.

The technical meetings opened in the afternoon. Ten papers were presented on Wednesday with some of the presentations going on simultaneously. This procedure prevailed throughout the meeting and made it possible to have a total of 34 technical presentations including three ASME papers on petroleum topics, and a management panel discussion before 5:00 p.m. on the fourteenth. Many phases of engineering work were covered by the speakers but the emphasis of the meeting was on the Canadian oil and gas.

Vice-President R. M. Hardy of Edmonton chaired the dinner on Wednesday evening at which retiring President V. A. McKillop was the speaker.

Wednesday's technical presentations finished at noon and during the afternoon a golf tournament and a bus tour through the mountains formed the program.

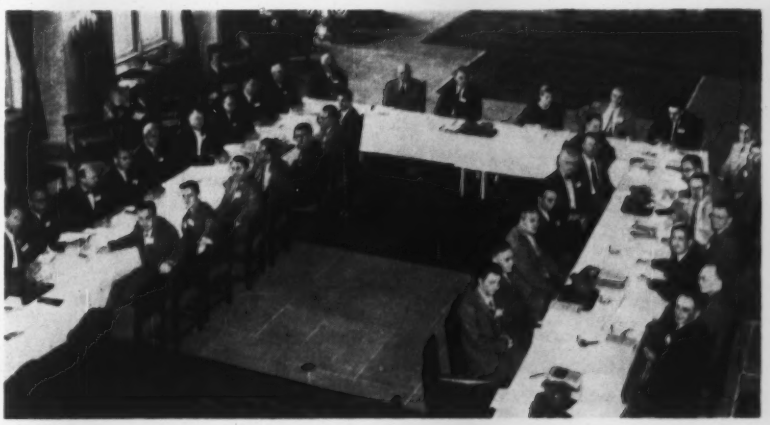
That evening the annual dinner of the Canadian Association of Consulting Engineers and the "EIC Petroleum Dinner" were held simultaneously. At the Institute dinner the speaker was C. O. Nickle of Calgary who gave a clear and concise verbal picture of the past, present, and future of Canadian oil and gas developments and reserves. J. C. Sproule of Calgary was the chairman. Following the two dinners there was a presentation of the "Pipeline Musical Revue," written, produced, sung, and acted by the wives and members of the Calgary Branch of EIC. This show was, undoubtedly, the entertainment high light of the meeting. It was topical, tuneful, and clever.

Throughout Thursday morning the new council held its first meeting and in the afternoon the Consultants held their annual meeting.

Technical Sessions

On Friday, the fourteenth, technical sessions went on continuously from 9:00 a.m. until noon and were resumed at 2:00 p.m. with final papers of the meeting being presented at 4:00 p.m.

Vice-President R. L. Dunsmore chaired Friday's luncheon at which retiring president Vernon McKillop presented



Conference on Engineering Education shown in session. The conference attracted 38 educators from 16 universities. The meeting was held Tuesday, June 11, at the Banff Springs Hotel, complementary to the annual meeting of The Engineering Institute of Canada. Dean H. G. Conn of Queen's University presided.

IN CANADA— EIC President V. A. McKillop and ASME President W. F. Ryan are shown signing the revised agreement for mutual co-operation between the two societies. L. Austin Wright, EIC General Secretary, looks on. The signing ceremony took place in Montreal, P. Q., Can., May 6, 1957, during the ASME-EIC International Council meeting.

certificates of honorary EIC membership to: J. O. Martineau, Quebec, Que.; A. G. L. McNaughton, Ottawa, Ont.; P. M. Sauder, Lethbridge, Alta.; W. S. Wilson, Toronto, Ont. Prizes and medals of the Institute were awarded as well.

Following the presentation of the awards, President McKillop unveiled a stainless-steel plaque commemorating Henry J. Cambie, a pioneer railroad engineer who spent most of his professional life in the west surveying and building lines for the C.P.R. The plaque will be permanently located in the C.P.R. station at Vancouver.

The Management panel, held in the afternoon, was an outstanding success. Bruce A. C. Hills of Montreal, president of Urwick Currie Limited, was the chairman. His copanelists were R. A. Emerson, Montreal, vice-president, operations and maintenance, Canadian Pacific Railway; D. M. Stephens, chairman and general manager; Manitoba Hydro Electric Board; A. L. Bishop, president, Consumers Gas, Ltd., Toronto; W. H. Young, manager Chemical-Metallurgical Division, Sherritt Gordon Mines Ltd., Fort Saskatchewan, Alberta.

C. M. Anson of Sydney, N. S., *left*, being congratulated by V. A. McKillop of London, Ont. Mr. Anson succeeded, on June 14, Mr. McKillop as president of The Engineering Institute of Canada. Mr. Anson took office at the 71st annual EIC meeting.

The Annual Banquet on Friday night was one of the most colorful events of the meeting. The head-table guests were "piped-in" by a woman piper—and they were a true representation of the engineering profession of Canada, Britain, and the United States. Justice S. Freedman of the Court of Queen's Bench, Manitoba, was the speaker and he based his address on Canadian and world events during the first 70 years of the Institute, 1887–1957. His humor, pathos, descriptions, and conclusions completely held his audience.

The formal part of the evening concluded with Vernon A. McKillop turning over the presidency of the Institute to Clement M. Anson. This was done before an audience which gave Mr. McKillop and Mr. Anson a standing ovation. Immediately after this dinner the annual EIC ball commenced.

Throughout the meeting the women had a program of interesting and entertaining events.

On Saturday morning many of the engineers and their wives left for tours of some of the Alberta oil fields and parts of the Trans-Canada Highway.

Availability List—ASME-EIC Petroleum Papers

THE papers in this list are available in separate copy form until April 1, 1958. Please order only by paper number otherwise the order will be returned. Copies of these papers (25 cents to members; 50 cents to nonmembers) may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	*Title and Author*
57—ASME-EIC-1	Automatic Computing for Process-Unit Operating Guides, by H. F. MOORE
57—ASME-EIC-2	The Peace River and Alaska Highway Gas-Gathering System, by A. L. BERRY and B. L. MOREAU
57—ASME-EIC-3	Manufacture and Metallurgy of Flash-Welded Line Pipe, Part 1, by M. A. SCHEIL, G. E. FRATCHER, S. L. HENRY, and E. H. UECKER
57—ASME-EIC-4	Brittle Fracture in Steel as Related to Flash-Welded Line Pipe, Part 2, by M. A. SCHEIL, G. E. FRATCHER, S. L. HENRY, and E. H. UECKER
57—ASME-EIC-5	Low-Temperature Burst Tests of Flash-Welded Line Pipe, Part 3, by M. A. SCHEIL, G. E, FRATCHER, S. L. HENRY, and E. H. UECKER

D. M. Boyd Reports on Evolution of Japanese Industrial Revolution

Presents ASME Scroll of Congratulations to Japan Automatic Control Society in Tokyo

An industrial revolution which is adding new significance to the legend "Made in Japan" is beginning to swell like an incoming tide in that Far Eastern country, says David M. Boyd, Jr., Mem. ASME, head of Universal Oil Products Company's instrument department.

Mr. Boyd, who was guest of honor and principal speaker at the celebration April 16 of the founding of the Japan Society of Automatic Control in Tokyo, reported on his return that increasing emphasis is being placed upon the production of precision scientific equipment rather than inexpensive goods for which the Japanese were noted prior to World War II. He also served as Honorary ASME Vice-President, representing the Society at the celebration.

Japan's rise in stature as a producer of highest quality precision scientific equipment can be laid at the doorstep of the Imperial Navy which, prior to Pearl Harbor, prodded the optical industry into producing fire-control instruments of exceptional merit, Mr. Boyd said.

Optical Industry Shows the Way

Encouraged by the results of this venture, the optical industry turned its attention to the photographic market. Through joint research efforts of all Japanese optical firms, a new glass was developed which had a higher index of refraction than any other then on the market. Thus the Japanese were able to produce faster and better lenses for such equipment as cameras, microscopes, surveying instruments, field glasses, and the like than had been made previously.

He said that the success of the optical firms in capturing a large share of the world markets in their fields so encouraged other types of industry to strive for quality products that they began setting higher standards for their goods, and thus were sown the seeds of the industrial revolution.

Precision Equipment Follows

Now, Mr. Boyd reported, there is growing evidence that Japanese industry is concentrating on producing precision scientific equipment because low volume and the extreme degree of accuracy required do not lend themselves to automatic production. He said the quality products being made are not economical to produce in the United States because of the large number of man-hours required, whereas in Japan there is a tremendous pool of inexpensive labor.

Industrial Revolution

But this industrial revolution has created a serious problem for the Japanese, Mr. Boyd believes, because it has brought about an acute shortage of technically trained engineers—a situation which has a striking parallel in the United States. Mr. Boyd said: "I detected a serious obstacle which the Japanese must overcome quickly if the industrial revolution is to continue at its present rapid pace, namely, a lack of cooperation between industry and institutions of higher learning.

"Industry feels that colleges and universities are too theoretical in their approach to problems, while on the other hand the schools believe that industry is too materialistic, and unwilling to pay for brain power. There must be a meeting of minds whereby industry employs professors as consultants in order that the educators may learn some of the practical problems found outside of the classroom, and industry may determine how the application of theory can improve the quality of production."

Mr. Boyd's appearance before the Japan Society of Automatic Control was the high point of a trip to the Orient which lasted nearly a month. A large group of automatic control engineers from the Tokyo area heard him discuss the "Effect of Hysteresis on the Derivative Control Function" as the keynote talk at the tenth anniversary celebration, which was held in Tokyo's University Club.

The UOP instrument chief presented scrolls from the American Institute of Chemical Engineers and The American Society of Mechanical Engineers, and a gavel from the Instrument Society of America to Dr. Kankuro Kaneshige, president of the Japan Society of Automatic Control.

He presented a paper entitled "Recent Advances in Process Control" before a joint meeting of the Society of Chemical Engineers of Japan, the Chemical Society of Japan, and the Fuel Society of Japan on April 18, also at the University Club.

The same paper was read before a meeting of Universal process licensees in

D. M. Boyd, Jr., *right,* presents ASME scroll of congratulations to Prof. Kankuro Kaneshige, *left,* president, Japan Society of Automatic Control, on the tenth anniversary of the society's founding, April 16, in Tokyo. Prof. Yasundo Takakashi, *center,* smilingly approves.

the Far East on the next day at the University Club, and he repeated it on April 22 and 26, at the University of Kyoto and on the Island of Kyushu, before branches of the Japan Society of Automatic Control and the Society of Chemical Engineers of Japan. These groups presented him with a 150-year-old, gold-handled Japanese throwing knife, which is now used as a letter opener, at the conclusion of his appearance at the university.

Before returning home, Mr. Boyd visited all petroleum refineries in Japan which license UOP processes.

UET's Engineering Foundation Makes Grants to 28 Projects

ENGINEERING research will go forward on a wide front with new grants made by the Engineering Foundation, a department of United Engineering Trustees, Inc., at its annual meeting held in New York, N. Y., May 16. Appropriations for the 1957–1958 fiscal year total $69,000. They will initiate or advance 28 projects, which will receive nearly $1 million in industry support. The projects to which funds have been allocated represent all the important branches of the profession. They are being carried out in university, government, and industrial laboratories all over the country under sponsorship of the major engineering societies.

Column Research Council

This year, Engineering Foundation is making a special grant of $3500 for an important new project of the Column Research Council, which promises ultimately to yield safer, cheaper structures. A special grant—contingent on the project's receiving an equal amount of outside support—will be used in preparing a general guide for the preparation of specifications on the subject of metal columns and compression members. The new project is aimed at making use of new data relating to the strength of compression members by offering the profession an over-all guide, with optional clauses covering a variety of situations. It will supplement rather than supplant existing specifications and make available for practical application the results of scientific research. The proposed guide will be dedicated to the late Shortridge Hardesty, long-time member and chairman of the Column Research Council.

In the eleven years of its existence, the Council, which is under the auspices of the American Society of Civil Engineers, has accumulated a great deal of valuable material on column behavior. Council headquarters have recently been changed from Lehigh University to the University of Michigan.

Alloys of Iron Research

Alloys of Iron Research is receiving $5000 to continue its work of publishing monographs devoted to important findings on carbon and alloy steels and cast irons. This June the project issued the fourth monograph of a new series, entitled "Boron, Calcium, Columbium, Tantalum, and Zirconium in Iron and Steel," which is of much interest to the manufacturers of jet engines and guided missiles. The new monograph contains a summary of valuable material on the complex, high-temperature alloys that have been developed in the past five or ten years. It is these new alloys which are making jet engines and more efficient power plants possible because they can withstand higher temperatures than ordinary steel. Alloys of Iron Research has been receiving Engineering Foundation support since its formation in 1929. It is a project sponsored by the American Institute of Mining, Metallurgical, and Petroleum Engineers.

Corrosion Research Council

An allocation of $4000 goes to the Corrosion Research Council—also an AIME-sponsored project—which completed its first year on Dec. 31, 1956. One of the scientifically important facts already revealed by the Council's first program is that light slows down the rate of corrosion in water containing air. Furthermore, exposure to a beam of light apparently causes the oxide film on metal to dissolve. This research is being done in co-operation with the National Bureau of Standards. Since January the two groups have been engaged in a second joint project, which will explore the relation of stress to corrosion of metals. A study of the role of hydrogen is included in this project.

High-Temperature Steam Generation

Studies in High-Temperature Steam Generation, a long-time project sponsored by The American Society of Mechanical Engineers, will be given a token grant of $1000. The latest development in this program is that, on the basis of findings of prototype equipment previously operated at the Naval Engineering Experiment Station at Annapolis, test equipment for determining the behavior of alloy steels under high-temperature steam has been installed at the Philip Sporn Power Plant at New Haven, W. Va. After several months of shake-down testing, the apparatus has begun a three-year operation under planned steady-state conditions, in which specimens are subjected to combustion gases and steam at temperature levels between 1100 and 1500 F. Specimens will be removed for examination at regular intervals; the first set was scheduled for observation in May. The High Temperature Steam Generation Project is of vital importance to industry and is being heavily subsidized by manufacturers and by the U. S. Navy Bureau of Ships.

Council on Wave Research

Of considerable concern to residents of coastal areas as well as to beach-front property owners is another research program that continues to receive Engineering Foundation support. The Council on Wave Research, which was set up to survey the various fields of water-wave action, had its origin in the Hydraulics Division of ASCE. It is now operating as an independent program. In its seven years of operation the Council has sponsored numerous conferences on coastal engineering and allied subjects. This fall it will have its Sixth Conference on Coastal Engineering, to be held in Florida under sponsorship of the University of Florida.

These projects are a typical sampling of the wide range of engineering and scientific work receiving Engineering Foundation support in this pioneer organization's forty-third year of operation. Since its formation in 1914, the Foundation has made sound use of its relatively modest income to initiate and develop important research programs that were later able to attract large-scale industrial backing. Its current endowment fund of about $1.5 million includes a residual bequest of some $400,000 recently made available to it from the estate of the late Edwin H. McHenry, civil engineer and railroad executive.

Nuclear Graphite Goes to School. Students at The Massachusetts Institute of Technology study nuclear fission with a subcritical pile which they have constructed themselves. T. J. Thompson, professor of nuclear engineering at M.I.T., discusses a laboratory test with a group of students. An indium disk will be placed in the slot he is discussing, and will later be checked with a Geiger counter in an experiment to determine the atomic activity of the pile. The natural uranium in the pile is activated by one of the first new plutonium-beryllium neutron sources to be released by the U. S. Atomic Energy Commission.

1957 Heat Transfer and Fluid Mechanics Institute Papers Available

HELD June 19-21 at the California Institute of Technology, Pasadena, Calif., the 1957 Heat Transfer and Fluid Mechanics Institute papers are now available. The institute was presented with joint sponsorship of the following institutions and technical societies: Stanford University, University of California, Berkeley and Los Angeles, University of Santa Clara, University of Southern California, California Institute of Technology, The American Society of Mechanical Engineers, American Institute of Chemical Engineers, American Society of Refrigeration Engineers, Institute of the Aeronautical Sciences, and Society of Automotive Engineers.

The papers are as follows:

The Sound Generated by Interaction of a Single Vortex With a Shock Wave, by G. I. RAM and H. S. RIBNER, Institute of Aerophysics, University of Toronto, Toronto, Canada.

On The Instability of Small Gas Bubbles Moving Uniformly in Various Liquids, by R. A. HARTUNIAN and W. R. SEARS, Cornell University, Ithaca, New York.

The Fluid Flow Associated With the Impact of Liquid Drops With Solid Surfaces, by P. SAVIC and G. T. BOULT, National Research Laboratories, Ottawa, Canada.

Transformation of the Compressible Turbulent Boundary Layer, by ARTUR MAGER, Marquardt Aircraft Company, Van Nuys, California.

The Unsteady Laminar Boundary Layer of a Wedge, and a Related Three-Dimensional Problem, by F. K. MOORE, Cornell Aeronautical Laboratory, Buffalo, New York.

The Laminar Boundary Layer Near a Sonic Throat, by DONALD COLES, California Institute of Technology, Pasadena, California.

Some Problems of Laminar Boundary Layer Shock Wave Interaction, by ISAAC GREBER, RAIMO J. HAKKINEN, LEON TRILLING, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Cooling of Solid Surfaces With Heat Power Inputs Over 10^6 Watts/Cm.^{2}, by DANIEL E. BLOXSOM, JR., Marquardt Aircraft Company, Van Nuys, California.

The Chemical Kinetics of Air at High Temperatures: A Problem in Hypersonic Aerodynamics, by SAUL FELDMAN, AVCO Manufacturing Company, Everett, Massachusetts.

Inviscid Hypersonic Flow Over Blunt-Nosed Slender Bodies, by TOSHI KUBOTA, California Institute of Technology, Pasadena, California.

General Properties of Normal Shock Waves at Hypersonic Speeds, by J. C. BRADLEY, RIAS, Incorporated, Baltimore, Maryland.

An Investigation of Stagnation Point Heat Transfer in Dissociated Air, by PETER H. ROSE and F. R. RIDDELL, AVCO Research Laboratory, Everett, Massachusetts.

Heat Transfer to Surfaces in the Neighborhood of Protuberances in Hypersonic Flow, by M. H. BLOOM and ADRIAN PALLONE, Polytechnic Institute of Brooklyn, Aerodynamics Laboratory, Freeport, New York.

Emissivity of High Temperature Air, by JAMES KECK, BENNETT KIVEL, TUNIS WENTINK, JR., AVCO Research Laboratory, Everett, Massachusetts.

Analysis of Steady, Finite-Amplitude Cellular Flames, by G. H. MARKSTEIN, Cornell Aeronautical Laboratory, Incorporated, Buffalo, New York.

Ignition in the Laminar Boundary Layer of a Heated Plate, by DONALD A. DOOLEY, Aeronutronics Systems, Incorporated, Glendale, California.

Ignition in Transient Flows, by D. BITONDO, N. THOMAS, D. PERPER, Aerophysics Development Corporation, Santa Barbara, California.

Experimental Investigation of Mass Transfer by Sublimation From Sharp-Edged Cylinders in Axisymmetric Flow With Laminar Boundary Layer, by W. J. CHRISTIAN, Armour Research Foundation, and S. P. KEZIOS, Illinois Institute of Technology, Chicago, Illinois.

The Heat Balance Integral and Its Application to Problems Involving a Change of Phase, by THEODORE R. GOODMAN, Allied Research Associates, Incorporated, Boston, Massachusetts.

The Influence of Solid Body Rotation on Screen-Produced Turbulence, by STEPHEN C. TRAUGOTT and HSUAN YEH, University of Pennsylvania, Philadelphia, Pennsylvania.

Some Effects of Isotropic Turbulence on a Pendulum at Moderate Reynolds Number, by WILLIAM H. SCHWARZ, Stanford University, Stanford, California, and STANLEY CORRSIN, The Johns Hopkins University, Baltimore, Maryland.

Copies of these papers are available as a complete preprint volume on order from the Stanford University Press, Stanford, California, at the price of $8.50.

ASME News

With Notes on Society Activities and Events

E. S. Newman, *News Editor*

1957 ASME Fall Meeting Offers More Variety Than Ever

Inspection trips concentrate on transportation—whaling ship to atomic sub

THE 1957 Fall Meeting of The American Society of Mechanical Engineers to be held at the Hotel Statler, Hartford, Conn., September 22-25, will offer many outstanding features in addition to the technical papers to be presented.

Included among the feature events will be an address by Dr. William F. Ryan, ASME President, at the President's Luncheon on September 23 and an address by Dr. Gaylord P. Harnwell, President of the University of Pennsylvania, at the Banquet on September 24. In addition to these major meal-time events, there will be a Social Hour and Buffet Supper and dancing the evening of September 23, and a luncheon sponsored by the American Rocket Society on September 24 at which Colonel John P. Stapp of the Holloman Air Development Center will speak.

Several interesting trips have been planned in connection with the meeting—with concentration on transportation from the old-time whaling ships at Mystic, to helicopters, to atomic-powered subs. On Tuesday, September 24, the Sikorsky Helicopter Division of United Aircraft Corporation at Stratford, Conn., will be visited. This brand new plant offers much to be seen in up-to-date manufacture of wingless aircraft. Concurrently the women will visit The International Silver Company at Wallingford, Conn., on Wednesday, September 25. An all-day trip to The Electric Boat Division of General Dynamics Corporation at Groton, Conn., will include a conducted tour of the plant's vast operations including the Navy's several atomic projects—Skipjack, Skate, and Triton—presently under way. After lunch, the group will have the privilege of experiencing a submarine ride both on Long Island Sound and submerged.

After the inspection trip the group will then go to Mystic Village for an old-style New England clambake. New Englanders know what that means, everyone else should find out. An alternate trip on Wednesday also is offered in the afternoon to historic Mystic Seaport later to join in the New England clambake. Mystic Seaport is more than a museum, it is a living 19th century seaport with its quaint—but still in use shops. Here are still to be seen wooden whaling ships and the men—on land and sea—who serve them.

Among the high lights of the technical program are numerous sessions on hydraulics, gas turbine power, aviation, safety, machine design, management, production engineering, education, materials handling, heat transfer, applied mechanics, lubrication, and a five-session metals engineering symposium on the casting of metals. The program schedule follows:

▶Monday, September 23

8:00 a.m.

Registration

9:30 a.m.

Hydraulic

Losses in Flow Normal to Plane Screens, by *W. G. Cornell*, General Electric Co. (Paper No. 57—F-19)

A Method for the Prediction of Boundary-Layer Separation and Growth for Application to Turbine-Blade Design, by *B. A. Jones*, United Aircraft Corp. (Paper No. 57—F-30)

9:30 a.m.

Gas Turbine Power (I)—Aviation (I)

Manufacturing Small Engines, by *L. W. Watt*, General Electric Co. (Paper No. 57—F-20)

General Design Considerations for Smaller Gas Turbines, by *W. T. von der Nuell*, The Garrett Corp. (Paper No. 57—F-13)

Dynamic Stability of Gas Turbines, by *S. L. Soo*, Princeton University, and *Wm. W. S. Charters*, Rolls Royce, Ltd., Derby, England (Paper No. 57—F-22)

9:30 a.m.

Safety—Machine Design (I)

Panel Discussion: "Safety in Machine Design"

The Why of Safe Design: *John Grimaldi*, General Electric Co.

The What of Safe Design: *Nicholas Prasinos*, *Modern Materials Handling*

The How of Safe Design: *H. H. Mabie* and *H. J. Loberg*, Cornell University

9:30 a.m.

Management (I)

Project Control

Project Control in Engineering Development, by *G. L. Thuering*, Pennsylvania State University (Paper No. 57—F-2)

Organize Your Engineering Project, by *M. C. Tourtellotte*, Michigan Seamless Tube Co. (Paper No. 57—F-11)

12:15 p.m.

President's Luncheon

Presider: *Dwight Douglass*, vice-president, Connecticut Power Co.

Address by: *William F. Ryan*, ASME President

Subject: **A Survey of the Engineering Profession**

2:30 p.m.

Production Engineering (I)—Management (II)

Industrial-Engineering Management[1]

Control of Engineering Work in a Product-Development Laboratory[1]

[1] Paper not available—see box on page 794.

Inspection trips span past with future... The cobbled seaport street at Mystic Seaport is a path to the Counting House, apothecary shop, Edwards House, Colegrove Memorial, Packer Shed, firehouse, shipsmith shop, sail loft, and ropewalk of yesteryear. At *right* one sees the schooner *Australia*.

Registration Schedule

Sunday, September 22, 3:00 p.m. to 5:00 p.m.
Monday, September 23, 8:00 a.m. to 8:00 p.m.
Tuesday, September 24, 8:00 a.m. to 3:00 p.m.
Wednesday, September 25, 8:00 a.m. to 3:00 p.m.

2:30 p.m.

Machine Design (II)

A Numerical Method for Determining Cam-Follower Response, by *H. A. Rothbart*, City College of New York (Paper No. 57—F-17)

Control of Steam-Jet Vacuum Pumps, by *C. G. Blatchley*, Schutte & Koerting Co. (Paper No. 57—F-15)

Proposed Standardized System for Notation and Classification of the Four-Bar Linkage, by *B. L. Harding*, Heald Machine Co. (Paper No. 57—F-28)

2:30 p.m.

Metals Engineering (I)

The Evaluation of Ductile Iron as an Engineering Material[1]

Mechanical Properties of Gray Cast Iron[1]

Development and Testing of Magnesium Alloy Wheels[1]

2:30 p.m.

Gas Turbine Power (II)—Aviation (II)

The Industrial and Marine Use of Lycoming Turbines[1]

Design Features of a Gas Turbine for a Supercharged Boiler[1]

A 1500-Hr Accelerated Service Test on Two Shipboard Gas-Turbine Engines, by *P. W. Pichel*, Solar Aircraft Co., *David E. Blackwood*, Bureau of Ships, and *W. P. Henry, Jr.*, Solar Aircraft Co. (Paper No. 57—F-21)

2:30 p.m.

Education (I)

Discussion: Graduate Engineering Program at Rensselaer Polytechnic Institute, Hartford Center

3:30 p.m.

High-School Seminar

"Your Future in Engineering"

8:00 p.m.

Junior—Education (II)

Panel Discussion: "What Can a Young Engineer Do to Develop Professionally?"

Peter Wallack, General Motors Corp.
W. C. Beckley, The Whitlock Manufacturing Co.
Frank Shires, The Terry Steam Turbine Co.

▶Tuesday, September 24

8:00 a.m.

Registration

[1] Paper not available—see box on page 794.

9:30 a.m.

Production Engineering (II)

The Use of Numerically Controlled Machine Tools, by *M. V. Hayes*, Jones & Lamson Machine Co. (Paper No. 57—F-14)

Numerically Controlled Jig Borers[1]

9:30 a.m.

Machine Design (III)

Power Drives and Controls for the Textile Industry—Part 1

Modern Textile Motors, by *J. B. Wren*, Westinghouse Electric Corp. (Paper No. 57—F-16)

The Slip-Ring Induction Motor—A Versatile Tool for Machinery Drives[1]

DC Braking of AC Motors in the Textile Industry[1]

9:30 a.m.

Metals Engineering (II)

Correlation of Elevated Temperature Data on Steel Castings[1]

Process Controls for Making Turbine Castings[1]

Weld Fabricated and Repaired Steel Castings for Nuclear Service[1]

9:30 a.m.

Materials Handling (I)

Materials-Handling System for Job-Shop Production Control, by *J. R. Mandel*, Western Electric Co. (Paper No. 57—F-27)

Material-Handling Contributions to Inventory Control[1]

9:30 a.m.

Heat Transfer

Heat Transfer to Fluids With Low Prandtl Numbers for Flow Across Plates and Cylinders of Various Cross Sections, by *R. D. Cess*, Westinghouse Research Laboratories and *R. J. Grosh*, Purdue University (Paper No. 57—F-29)

Total Normal Emissivity Measurements for Porous Materials Used for Mass-Transfer Cooling, by *T. F. Irvine, Jr., J. P. Hartnett*, and *E. R. G. Eckert*, University of Minnesota (Paper No. 57—F-8)

Thermal Conductivity of Insulating Materials for Use in Nuclear Reactors, by *W. R. Morgan* and *W. G. Baxter*, General Electric Co. (Paper No. 57—F-9)

Thermodynamic Properties of Compressed Water, by *T. C. Tsu* and *D. T. Beecher*, Westinghouse Electric Corp. (Paper No. 57—F-10)

12:15 p.m.

American Rocket Society Luncheon

Address by: *Colonel John P. Stapp*, Holloman Air Development Center
Subject: **Space-Medicine Experiments**

2:30 p.m.

Machine Design (IV)

Power Drives and Controls for the Textile Industry—Part 2

Modern Adjustable Speed Drives for Textile Machinery, by *A. T. Bacheler*, Westinghouse Electric Corp. (Paper No. 57—F-23)

Research Techniques in Modern Machinery Development[1]

Power Drives for Warp Preparation Machinery, by *George Manning*, Cocker Machine & Foundry Co. (Paper No. 57—F-24)

2:30 p.m.

Metals Engineering (III)

The Virtues of Chill Cast Surfaces for Various Applications[1]

The Use of Nondestructive Testing on Steel Castings for Elevated Temperature Service[1]

Low Temperature[1]

2:30 p.m.

Materials Handling (II)

Analytical Methods in Materials-Handling Analysis, by *A. F. Gould*, Lehigh University (Paper No. 57—F-26)

Waiting Line Models in Materials Handling, by *R. B. Fetter* and *H. P. Galliher*, Massachusetts Institute of Technology (Paper No. 57—F-25)

2:30 p.m.

Applied Mechanics (I)

Bending Frequency of a Rotating Cantilever Beam, by *M. J. Schilhansl*, Brown University (Paper No. 57—F-6)

Natural Frequencies of Nonuniform Beams on Multiple Elastic Supports, by *R. A. Di Taranto*, Radio Corp. of America (Paper No. 57—F-5)

High-Order Accuracy in the Solution of Partial Differential Equations by Resistor-Networks, by *H. G. Landau*, Columbia University (Paper No. 57—F-1)

2:30 p.m.

Lubrication

Isoelasticity in Gyro Rotor Bearings[1]

Solution of Reynolds Equation for Finite Journal Bearings, by *Oscar Pinkus*, General Electric Co. (Paper No. 57—F-12)

Theoretical and Experimental Analysis of Hydrodynamic Gas-Lubricated Journal Bearings, by *B. Sternlicht* and *R. C. Elwell*, General Electric Co. (Paper No. 57—F-18)

7:00 p.m.

Banquet

Address by: *Gaylord P. Harnwell*, President of the University of Pennsylvania
Subject: **The Engineer as Interpreter of Modern Technology**

(Business Dress)

▶Wednesday, September 25

8:00 a.m.

Registration

9:30 a.m.

Applied Mechanics (II)

Force in the Plane of Two Joined Semi-Infinite Plates, by *Leif Rongved*, Bell Telephone Laboratories, and *J. T. Frasier*, Pennsylvania State University (Paper No. 57—F-7)

Torsion and Flexure of Slender Solid Sections, by *W. J. Carter*, University of Texas (Paper No. 57—F-4)

Tensor Flexibility Analysis of Closed-Loop Piping Systems, by *J. W. Soule*, United Engineers & Constructors, Inc. (Paper No. 57-F-3)

9:30 a.m.

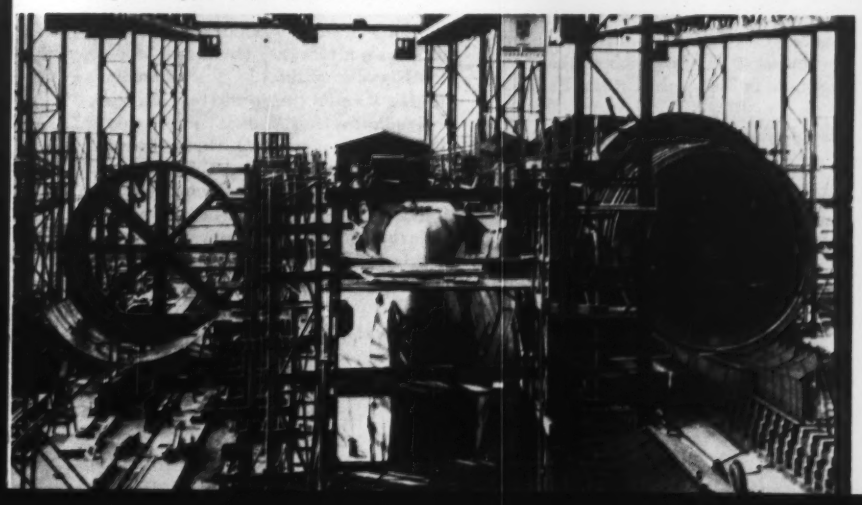
Metals Engineering (IV)

Specifications as Related to Design Quality in Steel Castings[1]

Functional Analysis to Final Design of a Steel Casting[1]

Design Characteristics of Magnetic Steel Castings[1]

Today's Atomic Lineup for Tomorrow. Three of the nuclear-powered submarines in the Navy's atomic building program are shown side by side on the Groton, Conn., building ways of General Dynamics Corporation's Electric Boat Division. *Left to right,* Skipjack, Skate, and Triton.



2:30 p.m.

Metals Engineering (V)

A sound, motion picture entitled "Photoelastic Studies of Joining Sections in Steel Castings and Weldments" will be presented by *G. K. Dreher*, Steel Founders' Society of America.

A 225,000-Psi Commercial Cast Steel[1]

Machining Large Steel Castings[1]

▶Women's Program

Sunday, September 22

2:30 p.m. Open House and "Get Acquainted" Party

Monday, September 23

8:00 a.m. Registration
8:30 a.m. Coffee Hour
9:30 a.m. Trip to Sturbridge Village, Mass., buffet lunch at Tavern on the Green
12:15 p.m. President's Luncheon
6:30 p.m. Cocktails, buffet supper, and dancing

Tuesday, September 24

8:00 a.m. Registration
8:30 a.m. Coffee Hour
9:30 a.m. Trip to International Silver Co., Wallingford, Conn. Luncheon at International Silver Co.
7:00 p.m. Banquet

Wednesday, September 25

7:30 a.m. Trip to Electric Boat in New London, Conn. Luncheon at Electric Boat, followed by submarine cruise. Outing concludes with New England clambake at Mystic Seaport
8:00 a.m. Registration
8:30 a.m. Coffee Hour
10:00 a.m. Tour of G. Fox & Co. department store
1:00 p.m. Tour of Mystic Seaport and clambake at the seashore

Orders for ASME Technical Papers

ONLY copies of *numbered* ASME papers will be available. Please order only by paper *number;* otherwise the order will be returned. Order your copies of *numbered* papers by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Production problems may delay the availability of some numbered papers. However, orders will be held for such papers only until Sept. 13, 1957.

Papers are priced at 25 cents each to members; 50 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons, or coupons which may be purchased from the Society. The coupons in lots of ten, are $2 to members; $4 to nonmembers.

Copies of unnumbered papers, listed in this program, *are not available* in advance of the meeting because the review of these manuscripts had not been completed when the program went to press. The author's name and company affiliation will appear with paper title in the final program (final program available only at meeting).

The November, 1957, issue of MECHANICAL ENGINEERING will contain a complete listing of all available papers.

Oil Capital Prepares for ASME Petroleum Conference

Oil—Refinery, Equipment, and Research—on display

TULSA, OKLAHOMA, recognized as the oil capital of the world and home of the International Petroleum Exposition, makes a fitting site for the 12th Annual Petroleum Mechanical Engineering Conference to be held September 22–25 at the Mayo Hotel. The conference, sponsored by the Petroleum Division of The American Society of Mechanical Engineers, is expected to attract over 800 petroleum executives and engineers to hear the program.

Technical Program

A total of 44 technical papers and two panel discussions will be included on the program. These will be devoted to the mechanical-engineering aspects of oil and gas drilling, production, processing, and pipelining. Subjects to be covered in the papers include the latest developments in air drilling and high-pressure well-head equipment, automatic control, engineering scheduling, and personnel rating, applications of gas turbines in refineries, plastic pipe for petroleum industry service, automatic field welding of pipelines, and new developments in pipeline coatings. The first panel discussion will be devoted to welding design and practices and the second will be devoted to the ASME Pressure Vessel Code.

The Mayo Hotel, headquarters for the four-day conference, is Oklahoma's largest hotel with 600 fully air-conditioned rooms, each with television and radio service. The hotel is considered to have one of the finest valet and laundry service installations in the Southwest. It boasts the largest meeting room in Tulsa, the Crystal Ballroom.

Oil—Refinery and Research

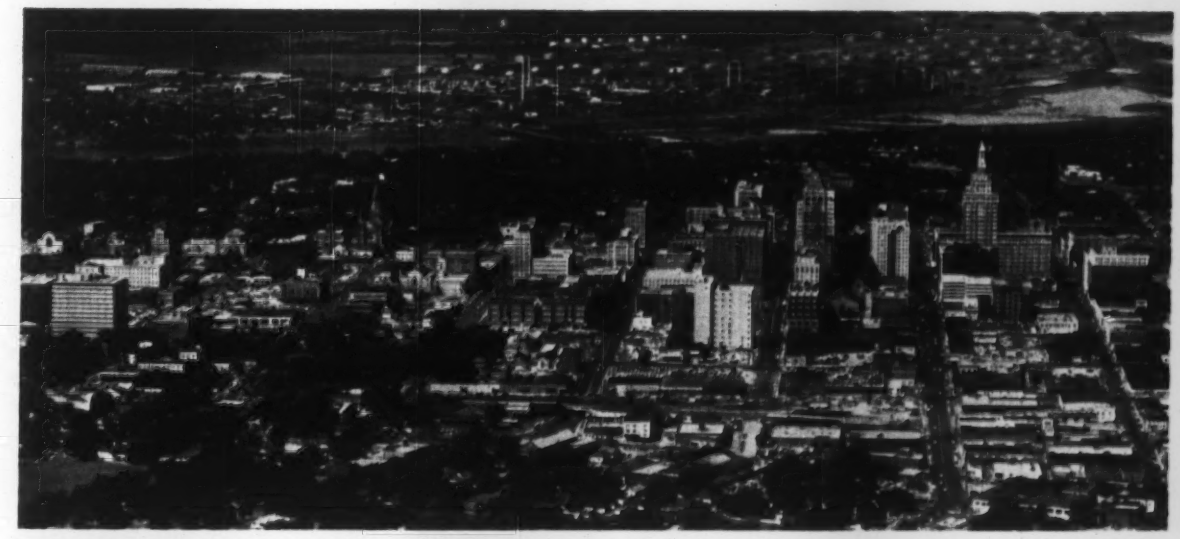
Forming an appropriate background scene for the highly informative conference are two large and modern refineries to be seen on Tulsa's sky line. In addition to the refineries, registrants at the conference can visit a number of oil-industry research centers. These include that of Pan American Petroleum Corporation, the largest research laboratory in the world devoted to research in oil exploration, development, and production. In fact, registrants will find the petroleum industry well represented in Tulsa, for nearly 800 oil companies maintain offices there. It is the control center for much of the oil production throughout the two hemispheres. In addition, Tulsa is headquarters for almost 50 independent geophysical concerns and for many large firms manufacturing instruments and equipment used in petroleum industry operations. Annual purchases of oil industry equipment and supplies from Tulsa exceed $600 million.

Tulsa is also national headquarters for the Independent Petroleum Association of America, the American Association of Petroleum Geologists, the Natural Gasoline Association of America, the Western Petroleum Refiners Association, and the United States Junior Chamber of Commerce.

Social Program

Besides the technical sessions for the petroleum conference, the program includes a number of other interesting activities. On the opening day, Sunday, the registrants and wives can meet with others at the conference at a get-acquainted session to be held in the hotel's Pompeian Court. At noon on Monday at the welcoming luncheon, those attending the conference will receive a formal welcome to the city by Tulsa's mayor, the Honorable George E. Norvell. Clifford H. Shumaker, ASME Vice-President of Region VIII, will give the response.

On Monday evening the registrants and their guests will be feted at an "hour of charm" in the Pompeian Court at the Hotel. Then on Tuesday at the annual industry luncheons, registrants will have the opportunity to lunch with others of a common field of interest and



Large modern oil refineries on Tulsa's sky line form an appropriate setting for the 12th Annual Petroleum Mechanical Engineering Conference, sponsored by the ASME Petroleum Division, September 22–25, at the Mayo Hotel

to meet the working ASME Petroleum Division committees in their respective branches of the oil industry. Five separate luncheons will be held—production, refining, transportation, materials, and manufacturers.

In the evening, Tuesday, members and guests will have the opportunity to attend an outstanding banquet and hear J. Carlton Ward, Jr., president, Vitro Corporation of America, whose subject, "Nuclear Energy as an Added Source of Future World Power," will prove highly interesting and informative to all.

Women's Program

Women attending the conference will be feted at a number of activities planned especially for them. For example, the program for Monday includes a tour of Tulsa's beautiful Philbrook Art Center housing original oil paintings valued at more than $2,500,000. The art center, of magnificent Italian Renaissance design, is home for a number of famous art collections, including the Samuel H. Kress collection of Italian Renaissance paintings and sculpture, the Laura A. Clubb collection of 18th and 19th century paintings, contemporary American Indian paintings, the George H. Taber collection of Chinese jade, ceramics, and decorative arts, and the Clark Field collections of American Indian Baskets and Pottery.

Not on the formal program but only a short drive from the Mayo Hotel are the Gilcrease Institute of American History and Art housing the greatest single collection in North America of the best work of American artists on Indian life and culture, and the Municipal Rose Garden, official test garden for the South of the All-American Rose Selections Committee, a six-acre garden of 9000 plants beautiful throughout the spring, summer, and fall.

ASME members and guests planning to attend the annual petroleum conference in September are urged to make their requests for hotel accommodations as early as possible to be assured of convenient access to the meetings and other activities. Already hotel registrations indicate attendance at the conference may well exceed advance estimates. Plans are under way to house additional registrants at the nearby Adams Hotel should attendance exceed expectations.

The tentative technical program follows:

▶Monday, September 23

8:00 a.m.

Registration

9:00 a.m. Ivory Room

Session 1—Inert Gas

Refining (I)

Chairman: *Albert Taylor*, manager, gas department, Amerada Petroleum Corp., Tulsa, Okla.

Vice-Chairman: *L. P. Sumpter*, director of engineering, natural gasoline department, Phillips Petroleum Co., Bartlesville, Okla.

Eight Years' Experience With Inert Gas Injection Equipment at Elk Basin,[1] by *G. O. Bates*, Pan American Petroleum Corp., Tulsa, Okla.

Safety Controls and Procedures for Inert Gas Machines,[1] by *C. H. Evans*, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

[1] Paper not available—see box on this page.

9:00 a.m. Room "U"

Session 2—Drilling Equipment

Production (I)

Chairman: *Gordon Jackson*, vice president, Eastman Well Survey Corp., Denver, Colo.

Vice-Chairman: *Stanley Moore*, president, Drilco Oil Tools, Inc., Midland, Texas

Appalachian Basin Air Drilling—Three Years' Experience,[1] by *H. J. Magner*, Delta Drilling Co., Pittsburgh, Pa.

Development and Field Testing of Wire Line Retractable Rock Bits,[1] by *J. M. Camp*, *R. H. Blood*, and *J. E. Ortloff*, Carter Research Laboratory, Tulsa, Okla.

9:00 a.m. Founders Room

Session 3—High-Pressure Well-Head Equipment

Manufacturers (I)

Chairman: *C. H. Taylor*, Shell Oil Co., Houston, Texas

Vice-Chairman: *Earl H. Harder*, The National Supply Co., Tulsa, Okla.

Availability of Papers

ONLY *numbered* ASME papers in this program are available in separate copy form until July 1, 1958. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 25 cents to members of ASME, 50 cents each to nonmembers. Papers must be ordered by the paper numbers listed in this program otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the Conference.

Experimental Development Work With 15,000 PSI Well-Head Connections,[1] by *R. C. Brooks*, Cameron Iron Works, Inc., Houston, Texas

Design Considerations for AWHEM 15,000 PSI Flanges,[1] by *Robert Eichenberg*, McEvoy Co., Houston, Texas

Control of 15,000 PSI Well Pressures,[1] by *C. A. Dunlop* and *T. V. Miller*, Humble Oil & Refining Co., Houston, Texas

9:00 a.m. Rooms "V" and "W"

Session 4—Gas Transmission

Transportation (I)

Chairman: *Burt T. Mast*, chief engineer, Trunkline Gas Co., Houston, Texas

Vice-Chairman: *Leon B. Dorsey*, gas & gas products division, Sinclair Oil & Gas Co., Tulsa, Okla.

Modernizing Compressor Station Piping,[1] by *M. J. Paul*, Natural Gas Pipe Line Co. of America, Chicago, Ill.

Two-Phase Flow Through Inclined Tubing,[1] by *R. L. Huntington*, University of Oklahoma

Comparative Cost of Pipeline Construction in Mountainous Areas Compared to That of Normal Rolling Country,[1] by *O. L. Carson*, Fish Northwest Contructors, Inc., Houston, Texas

2:00 p.m. Ivory Room

Session 5—Engineering Scheduling and Personnel Rating

Refining (II)

Chairman: *J. E. Ross*, Texas Division, The Dow Chemical Co., Freeport, Texas

Vice-Chairman: *J. A. Middleton*, maintenance and construction refining division, D-X Sunray Oil Co., Tulsa, Okla.

Scheduling Engineering Design—A Vital Force in Refining Operations, by *H. T. Campbell*, Humble Oil & Refining Co., Baytown, Texas (Paper No. 57—PET-3)

Evaluation and Development of Technical People,[1] by *Randall Meyer*, Esso Standard Oil Co., Baton Rouge, La.

2:00 p.m. Room "U"

Session 6—Drilling Hydraulics

Production (II)

Chairman: *Lyle L. Payne*, assistant vice-president of engineering, Hughes Tool Co., Houston, Texas

Vice-Chairman: *Robert M. Reed*, drilling engineer, Tulsa area, Shell Oil Co., Tulsa, Okla.

Reduced Pressure Drilling,[1] by *Roy M. Bobo*, Phillips Petroleum Co., Houston, Texas

An Investigation of Pressure Drop Through a Rotating Pipe, by *Howard Ferrell*, *E. C. Fitch*, and *J. H. Boggs*, Oklahoma Institute of Technology, Oklahoma State University

2:00 p.m. Founders Room

Session 7—Piping-Fabrication

Materials (I)

Chairman: *Roy L. Emerson*, Pittsburgh Piping & Equipment Co., Pittsburgh, Pa.

Vice-Chairman: *F. E. Pyeatt, Jr.*, Mid-Continent Pipe Line Co., Tulsa, Okla.

Automatic Field Welding of Pipelines,[1] by *H. C. Price*, H. C. Price Co., Bartlesville, Okla.

Requirements for Fabrication of Pressure Piping as Related to Service,[1] by *C. R. Soderberg, Jr.*, The M. W. Kellogg Co., New York, N. Y.

▶Tuesday, September 24

8:00 a.m.

Registration

9:00 a.m. Ivory Room

Session 8—Mechanical Design

Refining (III)

Chairman: *E. J. Hander*, head, special service division, Asiatic Petroleum Corp., New York, N. Y.

Vice-Chairman: *C. Page Stanley*, vice-president, Dresser Engineering Co., Tulsa, Okla.

Mechanical Seals for Nonlubricating Hydrocarbons, by *A. L. Decker*, Ethyl Corp., Baton Rouge, La. (Paper No. 57—PET-2)

Economic Aspects of Combustion Gas Turbine Application in Refining Industry,[1] by *C. R. Apits*, Clark Brothers Co., Division of Dresser Operations, Inc., Houston, Texas

Overstrain and Bursting Strength of Thick Walled Cylinders, by *S. M. Jorgensen*, Foster Wheeler Corp., New York, N. Y. (Paper No. 57—PET-4)

9:00 a.m. Room "W"

Session 9—Offshore Equipment

Production (III)

Chairman: *Jack Marsee*, Loffland Brothers Co., Tulsa, Okla.

Vice-Chairman: *Fred L. Manton*, vice-president, Diesel Power Co., Tulsa, Okla.

An Approach to Deep Water Operations,[1] by *R. L. LeTourneau*, R. G. LeTourneau, Inc., Longview, Texas

Advancements in Diesel-Electric Power for Oil Field Equipment,[1] by *B. H. Hefner*, Electro-Motive Division, General Motors Corp., La-Grange, Ill.

9:00 a.m. Emerald Room

Session 10—Symposium—What's New In Pipeline Coatings

Transportation (II)

Chairman: *Robert L. Bullock*, Interstate Oil Pipe Line Co., Shreveport, La.

Vice-Chairman: *Jack P. Barrett*, Pan American Research Center, Tulsa, Okla.

Application of Plastic Tape to 122 Miles of 22-In. Diam Natural Gas Pipeline,[1] by *N. E. Miley*, American-Louisiana Pipe Line Co., Detroit, Mich.

Development and Application of High-Density Rubberized Asphalt Mastic Coating,[1] by *L. N. Brown*, Southern Natural Gas Co., Birmingham, Ala.

Application of Epoxy Coatings to Interior and Exterior of Large Diameter Pipe,[1] by *Raymond Crowe*, Transcontinental Gas Pipe Line Corp., Houston, Texas

9:00 a.m. Founders Room

Session 11—Stack and Flange Design

Materials (II)

Vice-Chairman: *K. N. Bradley*, Service Pipe Line Co., Tulsa, Okla.

Anchor Flange Design,[1] by *A. J. Del Buono*, Taylor Forge & Pipe Works, Chicago, Ill., and *E. O. Waters*, Yale University

Analysis and Design of Skirt Supports for Pressure Vessels,[1] by *N. A. Weil*, The M. W. Kellogg Co., New York, N. Y.

2:00 p.m. Ivory Room

Session 12—Panel Discussion—Welding Design and Practices

Refining (IV)

Chairman: *John J. Chyle*, director of welding research, A. O. Smith Corp., Milwaukee, Wis.

Vice-Chairman: *Bill E. Forney*, National Tank Co., Tulsa, Okla.

Panel Members

Leon C. Bibber, chief research engineer in welding, U. S. Steel Corp., Pittsburgh, Pa.

A. P. Maradudin, material laboratory, Standard Oil Co. of California, Segundo, Calif.

N. Rosek, welding technician, A. O. Smith Corp., Milwaukee, Wis.

J. Bland, senior project engineer, engineering research department, Standard Oil Co. of Indiana, Whiting, Ind.

D. V. Wilcox, welding engineer, engineering service department, Reynolds Aluminum Co., Louisville, Ky.

W. H. Skewis, member, ASA B-31 Piping Code, Sub-Committee 3, Midwest Piping Co., St. Louis, Mo.

J. P. Baughman, research and development engineer, maintenance department, The Dow Chemical Co., Freeport, Texas

2:00 p.m. Room "W"

Session 13—Production Controls

Production (IV)

Chairman: *Howard J. EnDean*, head, fluid lifting and handling section, production-engineering division, Gulf Research & Development Co., Pittsburgh, Pa.

Vice-Chairman: *S. H. Pope*, Tulsa division, Gulf Oil Corp., Tulsa, Okla.

Instrumentation and Controls—Centralia Waterflood,[1] by *K. W. Foster*, Shell Oil Co., Centralia, Ill.

Automatic Production of Oil from Wellhead to Pipeline,[1] by *E. C. Young*, Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.

2:00 p.m. Founders Room

Session 14—Rotary Drill Stem Connections

Manufacturers (II)

Chairman: *R. W. Wire*, president, Loffland Brothers Co., Tulsa, Okla.

Vice-Chairman: *Paul L. Gassett*, Gulf Oil Corp., Tulsa, Okla.

Torque Requirements for Rotary Shouldered Connections and Selection of Connections for Drill Collars,[1] by *A. P. Farr*, Hughes Tool Co., Houston, Texas

Report on the Results Obtained by Use of Controlled Drill Stem Torque Make-Up in Field Operations,[1] by *S. C. Moore*, Drilco Oil Tools, Inc., Midland, Tex.

▶Wednesday, September 25

8:00 a.m.

Registration

9:00 a.m. Ivory Room

Session 15—Materials of Construction

Refining (V)

Chairman: *John Colby*, works engineering department, Deer Park plant, Diamond Alkali Corp., Houston, Texas

Vice-Chairman: *Edward A. Bartolina*, vice-president, manufacturing division, Moorland Co., Tulsa, Okla.

Report on Strength of Welded Joints in Carbon Steel at Elevated Temperatures by a Special Task Group of the Petroleum and Chemical Panel of Joint ASTM-ASME Research Committee, presented by *W. B. Hoyt*, The M. W. Kellogg Co., New York, N. Y. (Paper No. 57—PET-1)

Plastic Pipe in the Petroleum Industry, by *G. C. Anderson*, United States Steel Corp., Pittsburgh, Pa.

9:00 a.m. Room "W"

Session 16—Drilling Equipment

Production (V)

Chairman: *Joseph R. Mahan*, The National Supply Co., Pittsburgh, Pa.

Vice-Chairman: *R. B. McCloy*, Big X Drilling Co., Inc., Oklahoma City, Okla.

Proved Concepts in Oil Field Roller Chain Drive Selection, by *R. A. Schakel* and *C. O. Sundberg*, Diamond Chain Co., Indianapolis, Ind.

Stress Effects of Rotary Straightening on the Collapse Resistance of High Strength Casing, by *R. E. Zinkham*, Jones & Laughlin Steel Corp., Pittsburgh, Pa.

9:00 a.m. Room "U"

Session 17—Pipeline Equipment and Military Fuel Handling

Transportation (III)

Chairman: *A. N. Horne*, Texaco-Cities Service Pipe Line Co., Tulsa, Okla.

Vice-Chairman: *T. S. Llewelyn*, Service Pipe Line Co., Tulsa, Okla.

A Practical Review of Positive Displacement Meter Proving Methods for Liquid Hydrocarbons,[1] by *M. L. Barrett*, Shell Oil Co., New York, N. Y.

Design and Application of Vertical Tank Booster Pumps,[1] by *Val Lobanoff*, United Centrifugal Pumps, Oakland, Calif.

Military Petroleum Logistics,[1] by *H. N. Darling*, Major, U. S. Army, Chief of Pipeline Operations, Petroleum Division, Office of the Quartermaster General, Washington, D. C.

9:00 a.m. Emerald Room

Session 18—Gaskets and Reformer Tubes

Materials (III)

Chairman: *F. K. Zerbe*, A. O. Smith Corp., Houston, Texas

Vice-Chairman: *J. W. Young*, Humble Oil & Refining Co., Baytown, Texas

Packing and Gaskets,[1] by *R. H. Koch*, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Furnace Tube Alloys for Hydrocarbon Pyrolysis and Steam Methane Reforming,[1] by *E. N. Skinner* and *B. B. Morton*, The International Nickel Co., New York, N. Y.

[1] Paper not available—see box on page 795.

2:00 p.m. Ivory Room

Session 19—Panel Discussion: ASME Pressure Vessel Code

Refining (VI)

Chairman: *E. O. Bergman*, member, ASME Boiler & Pressure Vessel Committee, and chairman, Subcommittee on Unfired Pressure Vessels, C. F. Braun & Co., Alhambra, Calif.

Vice-Chairman: *C. E. Rawlins*, member, Subcommittee on Unfired Pressure Vessels, ASME Boiler and Pressure Vessel Committee, Phillips Petroleum Co., Bartlesville, Okla.

Panel Members

G. S. Chadwick, Jr., secretary, ASME Subcommittee on Unfired Pressure Vessels, Union Carbide Chemicals Co., S. Charleston, W. Va.

E. C. Korten, member, ASME Boiler and Pressure Vessel Code Committee, Hartford Steam Boiler Inspection and Insurance Co., Hartford, Conn.

J. J. Murphy, member, ASME Subcommittee on Unfired Pressure Vessels, The M. W. Kellogg Co., New York, N. Y.

Walter Samans, member, ASME Boiler and Pressure Vessel Code Committee, consulting engineer, Philadelphia, Pa.

F. S. G. Williams, vice-chairman, Main Pressure Vessel Code Committee, Taylor Forge & Pipe Works, Chicago, Ill.

2:00 p.m. Room "W"

Session 20—Production Equipment

Production (VI)

Chairman: *H. L. Shatto*, Technical Services Division, Shell Oil Co., Houston, Texas

Vice-Chairman: *J. Zaba*, Pan American Petroleum Corp., Tulsa, Okla.

Multiple Parallel String Completions,[1] by *J. R. Feeser*, Brown Oil Tools, Inc., Houston, Texas

Surface Controlled Down Hole Safety Device for Offshore Production,[1] by *L. M. Wilhoit* and *P. S. Sizer*, Otis Pressure Control, Inc., Dallas, Texas

2:00 p.m. Room "U"

Session 21—Pipeline Operation

Transportation (IV)

Chairman: *J. L. Irvin*, Gulf Oil Corp., Houston, Texas

Vice-Chairman: *E. W. Upton*, The Refinery Engineering Co., Tulsa, Okla.

The Gilsonite Pipeline,[1] by *E. S. Warner*, Standard Oil Co. of California, San Francisco, Calif.

Studies in Oil Line Surges,[1] by *E. Waller*, Oklahoma State University

Centrifugal Compressor Pulsation Detector,[1] by *V. Long*, Texas Eastern Transmission Corp., Shreveport, La.

[1] Paper not available—see box on page 795.

Shown mapping plans for the 1957 Petroleum Mechanical Engineering Conference sponsored by the ASME Petroleum Division, to be held in Tulsa, Okla., September 22–25, are James E. Byers, vice-chairman, and Wayne C. Moody, chairman, Tulsa Arrangements Committee

Industrial Films

Uranium

"The Petrified River—The Story of Uranium" portrays the story of uranium from ore to isotopes to atomic energy. Deriving its title from the prehistoric rivers whose beds now lie buried in the mesas of the Colorado Plateau, this film has been produced by Union Carbide and Carbon Corporation in co-operation with the United States Bureau of Mines.

The 28-min, 16-mm, color and sound film has live and animated sequences. Requests to borrow prints of the film should be addressed to Graphic Services Section, U. S. Bureau of Mines, 4800 Forbes Street, Pittsburgh 13, Pa.

Mining Nickel

"Mining for Nickel" describes the search for nickel ore and the way it is located, the basic development of a mine, and the six methods used to extract the ore. A combination of animation and live photography, the 16-mm color and sound film runs 45 min.

Produced by the International Nickel Company, Inc., the film is available from its distributor, Rothacker, Inc., 729 Seventh Avenue, New York 19, N.Y.

Availability List

• The United States Office of Education has produced 457 training films for industry, agriculture, and health. Descriptions of the films may be found in a 20-page catalog issued by United World Films, Inc., distributors of the films.

The 16-mm, sound films are available for re-recording into any language. For further information write Mr. Leo Guelpa, manager, government films department, United World Films, Inc., 1445 Park Avenue, New York, 29, N.Y.

• "Westinghouse Sound Films," a catalog of 47 general interest, product information, and training films, is available without charge from Westinghouse. The booklet lists the company's 16-mm sound films and gives a brief description of each as well as instructions on how to obtain prints for showing. Subjects included in the series range from "What Is Electricity" to "Advanced Welding Techniques."

For a copy of the booklet, B-7077, write Westinghouse Electric Corporation, P. O. Box 2099, Pittsburgh 30, Pa.

Motion Pictures in Engineering

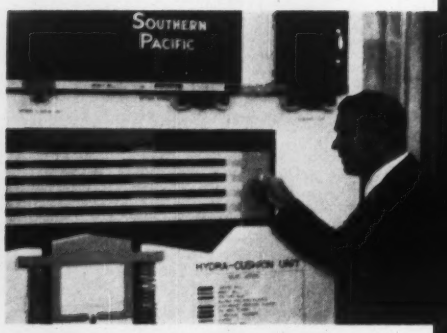
Information about recent advances in film sensitivity which have extended the scope of high-speed movies for industry is included in "High Speed Motion Pictures at the Service of the Engineer," a new Kodak pamphlet now ready for distribution.

Five illustrated case histories are used to show how major firms have used such movies to solve engineering problems. Data on Kodak films for black-and-white movies in the visible spectrum, in full color, and by infrared radiation are also given.

Facts on lighting, speed selection, and lenses for the Kodak High Speed Camera are part of the publication.

Copies of the pamphlet are available without charge from Professional Goods Division, Eastman Kodak Company, Rochester 4, N. Y.

1957 ASME SEMI-ANNUAL



Robert W. Hartwell, *left photo,* speaker at the Power-Nuclear Engineering Dinner, discusses the Enrico Fermi Atomic Power Plant. In *center photo,* Marvin D. Martin, *left,* who discussed nuclear engineering weapons at the Nuclear Engineering Luncheon, is shown with Captain Richard S. Mandelkorn. Railroad Luncheon speaker J. W. Corbett, *right photo,* demonstrates hydracushion underframe designed to reduce damage to freight cars and their contents.

ENGINEERS—1500 strong—intent on getting the most out of the 1957 Semi-Annual Meeting of The American Society of Mechanical Engineers, with its many technical sessions, scheduled luncheons and dinners, and plant trips, extended their curiosity to what makes San Francisco, Calif., one of the most unique cities in the country—the world, some will say.

There are few restaurants of note or merit which do not today have an "ASME stamp of approval," and to prove that engineers are "tourists" among the best of them they rode the Powell Street cable car to Fisherman's Wharf, visited Chinatown's array of curio shops, toured the three bridges—Golden Gate, San Francisco-Oakland, Richmond-San Rafael—enjoyed the 1013-acre Golden Gate Park with its authentic Japanese Tea Garden, and climbed up and down Telegraph Hill. A stop at the "Top of the Mark" also was a must on most everyone's list.

Technically, the meeting held June 9-14, at the Sheraton-Palace Hotel, in co-operation with the ASME San Francisco Section and in conjunction with the Semi-Annual Meeting of the American Rocket Society, covered a wide variety of topics, including jet-age aircraft, atomic power, safer industrial machines, new gas-turbine engines, air-pollution control, and improved mechanization and efficiency in a half-dozen industries. There were, in addition, numerous scheduled luncheons and dinners, a variety of plant tours, the presentation of the Wright Lecture, plus a well-planned Ladies' Program.

Feature Events

President's Luncheon

ASME President W. F. Ryan continued to emphasize the need for a comprehensive survey of the engineering profession. Speaking before the President's Luncheon on Monday, he pointed out for example, that the laws covering the professional registration of engineers in this country are "a misbegotten conglomeration" varying from state to state. He called for an extensive and exhaustive survey of the profession to point the way toward improving this situation. Dr. Ryan said that engineers need a professional status comparable to that of the medical profession, but that they must first develop a group consciousness.

Preliminary moves are already under way, he revealed, to conduct a survey of engineering comparable to the famous Flexner Report on medicine, published in 1910, which is generally credited with eliminating medical quacks in this country and raising the standards of medical education.

Dr. Ryan said that with the rapid expansion and diversification of engineering work brought on by technological advances, the profession is "bursting its seams and will fly asunder unless we take stock of what we are and what we are doing." He challenged his audience of engineers to write out a description of what an engineer is and what he does. He contended that engineers are frequently unable to distinguish their work from that of scientists or technicians.

Despite the handicaps under which the profession labors, he said, "American engineering education is the best in the world," and that a survey would not reveal any such scandalous conditions in engineering as existed in medicine prior to the Flexner Report. He said that American engineers have successfully conquered more problems in the operation of industry and in rapid application of new scientific discoveries than the engineers of any other nation. He added, however, that the profession is changing rapidly, due to new technical complexities, and is reaching the point

MEETING

At the President's Luncheon are shown, *left to right:* ASME President W. F. Ryan, Warren H. McBryde, and Mayor George Christopher of San Francisco

Chatting during the Banquet proceedings are: ASME President W. F. Ryan, H. Rowan Gaither, Jr., the banquet speaker, and James N. Landis, who was nominated for the presidency of ASME. Mr. Landis is a vice-president of the Bechtel Corporation, San Francisco, Calif.

where a "slide rule won't be enough—all the engineers will need giant computers."

In addition to helping to define the outlines of the profession, Dr. Ryan said, a survey such as one currently contemplated by Engineers Joint Council and Engineers' Council for Professional Development would enhance the usefulness of engineering to industry, to the nation, and to mankind.

President Ryan also suggested that educators and leaders of industry are failing in their responsibilities in not encouraging more women to enter the engineering profession and taking advantage of their talents once they do enter.

As part of the luncheon program, over which Warren H. McBryde, past-president and Fellow ASME, presided, ASME Members and guests were cordially welcomed to the city by San Francisco's Mayor George Christopher.

Power—Nuclear Dinner

Power Reactor Development Company, according to R. W. Hartwell, Mem. ASME, general manager of PRDC, Detroit, Mich., is a nonprofit organization comprised of 26 contributing manufacturing and public-utility companies. The Company has received a conditional construction permit from the Atomic Energy Commission for construction of a reactor of an advanced type, that is, a fast breeder reactor which will breed plutonium as well as produce power. The reactor was designed by Atomic Power Development Associates, Inc., another nonprofit organization. Commonwealth Associates, Inc., has been selected as architect engineers and United Engineers & Constructors, Inc., as construction engineers. It is estimated that the cost of the plant will be in excess of $43 million, of which $10 million will be for research and development.

Mr. Hartwell spoke at the Joint Power-Nuclear Dinner on Monday.

PRDC filed an application for license with the Atomic Energy Commission in January, 1956. The AEC issued a conditional construction permit on Aug. 4, 1956, to PRDC for construction of the 100,000-kw nuclear power plant near Detroit. Ground was broken for this plant on August 8 and construction has been proceeding satisfactorily. It is expected that the reactor will be operating in 1960, the scheduled date.

The application for a license was filed by PRDC after representatives of PRDC and APDA had met with the Advisory Committee on Reactor Safeguards of the AEC to discuss the design of this reactor, particularly the safety features. The report issued by the Advisory Committee, while it did not state that fast reactors were unsafe, indicated that the Committee thought further research necessary; however, PRDC representatives pointed out that the bulk of the research programs dealing with safety problems dealt with in the report were actually planned or under way. The AEC satisfied itself that questions as to safety could be successfully answered and that PRDC was proceeding in proper manner and the conditional construction permit was issued. The conditions in the permit required PRDC to furnish additional technical data as it became available, as well as additional financial information.

Since the construction permit was issued, PRDC has firmed up its financial position by obtaining unconditional commitments for contributions of $23,540,000 and a loan of $15 million.

Shortly after issuance of the construction permit, several members of the Joint Congressional Committee on Atomic Energy criticized the AEC, and on August 31 three labor unions filed a petition with the AEC requesting that (1) the permit be set aside until questions of safety and finance were resolved, and (2) a public hearing be held on the matter. The AEC refused to set aside the construction permit, but did order a hearing. The hearing began on Jan. 8, 1957, and is still in progress.

Mr. Hartwell stated that the AEC procedures for handling license applica-

tions had changed somewhat since the time the PRDC permit was issued. The Commission now publishes a notice of proposed action upon license applications in advance of the actual issuance of such a permit or license.

He digressed slightly to point out that legislation was recently introduced by Senator Clinton Anderson which would require the AEC to hold public hearings on all applications for licenses before issuance of the license. This legislation also provides that the report of the Advisory Committee on Reactor Safeguards be made part of the record of the application and available to the public. Mr. Hartwell pointed out that unless the developmental state of the act is recognized such legislation might well pose problems or delay since complete technical information relating to all factors of a reactor may not be available at the time the application is filed.

He then discussed the hearings in connection with the PRDC construction permit. He emphasized that the Company had no objection to public hearings; it was their feeling that public hearings were proper to protect the public.

In announcing the hearings the AEC specified among the issues to be considered the following:

1 Whether there is sufficient information to provide reasonable assurance that the reactor can be constructed and operated safely at Lagoona Beach.

2 Whether there is reasonable assurance that technical information omitted from and required to complete the application resulting from research carried on during the period of construction would be provided.

3 Whether or not PRDC is financially qualified to carry out the project.

In the petitions for intervention, the unions stated their main concern was the safety of the proposed reactor. However, during the extensive cross-examination a number of questions, which were irrelevant in connection with that issue, were introduced but which appeared designed to the foundation for criticism of the AEC or for a showing of improper subsidies to reactor builders. Typical of such lines of questioning was an exhaustive inquiry into the price of plutonium.

A great deal of direct testimony and cross-examination has already been completed, but it is expected that the transcript of the hearing will be more than 5000 pages long before the hearing is completed. Certification of the record to the Commission for decision was tentatively scheduled to be completed by July 1. Thus, a determination by the Commission will not be made earlier than the fall of 1957.

The matter of the safety of reactors is of paramount interest to the public, and it is proper and important that provision be made for public hearings—both for the protection of the public and for the protection of applicants for licenses. Reactor builders understandably desire some assurance that they will be able to operate when construction of a reactor is completed. Yet in a developmental art, complete and detailed technical data are not and can never be available at the institution of construction when an application for a construction permit must be made. Therefore, under the present regulatory pattern there is inherent a necessity for review of the completed reactor before an operating permit can be granted. In this situation an exhaustive and expensive hearing of the nature of the PRDC hearing at the construction-permit stage is uneconomic and would normally be warranted only if the construction permit would automatically become an operating permit upon completion of construction, which is not the case. It is to be hoped that such a situation will not be a recurrent one or the civilian-development program will be hampered. Because of the rapidly developing state of the art, it is reasonable to expect that the experience of PRDC may be unique.

R. A. Bowman, Mem. ASME, of Bechtel Corporation, presided.

Railroad Luncheon

Jet engines, and their huge appetite for fuels, present a major problem to the American Railroad industry, according to J. W. Corbett, vice-president of the Southern Pacific Company. Speaking at the Railroad Luncheon on Tuesday, he suggested that since locomotives and jet planes use the same kind of fuels, there might not be enough to go around in the future, especially in time of national emergency. He said that railroads are now exploring the possibility of running locomotives on new and different fuels, including, possibly, nuclear ones.

Even in peacetime, Mr. Corbett said, the need for economical operation demands research on less costly fuels.

Mr. Corbett predicted major improvements in both passenger and freight cars, including elimination of the troublesome "hot box" caused by overheated wheel bearings, and "impact damage" caused by jolts in transit.

He described newly developed devices called "hydracushion underframes" which operate on a shock-absorber principle to reduce damage to freight cars and their contents. Use of the new units, he said, has permitted railroads to handle fragile items without damage, including curved automobile windshields and other vulnerable freight.

A serious problem confronting the industry, Mr. Corbett pointed out, is the shortage of engineers in railroading. To induce young engineers to enter this field, Mr. Corbett outlined what the future in railroading holds for the mechanical engineer. For example, on the problem of motive power, Mr. Corbett pointed out that "while the diesel locomotive has been a major step forward in the advancement of railroad locomotion, I do not believe that we have reached the ultimate goal in motive power design. This is evident by the continual search for improvements in locomotives, including certain types currently under test. For example, the gas-turbine locomotive is in limited use on one major railroad and diesel engines with direct hydraulic drive are under test. One of the major engine builders is developing a free-piston gasifier to drive a gas turbine for locomotive use. The Association of American Railroads has a standing committee on atomic energy for the purpose of investigating the feasibility of nuclear power for locomotive use, either by means of a reactor aboard the locomotive unit or by transmitted electrical energy generated at a central nuclear power plant. In other words, the field of future development in locomotive design is wide open."

Other problems cited by Mr. Corbett include fuels resources, passenger-car design, freight car design, and the like.

H. C. Munson, vice-president and general manager, Western Pacific Railroad Company of San Francisco, presided.

Nuclear Engineering Luncheon

Engineers and scientists are constantly at work to make nuclear weapons safe for the people who use them and for surrounding civilian populations, according to Marvin D. Martin, Mem. ASME, head of the Weapons Engineering Division of the University of California Radiation Laboratory.

Addressing the Nuclear Engineering Luncheon on Wednesday, Mr. Martin pointed out that designers must guard against unintentional detonation as well as guarantee satisfactory performance when needed. If an aircraft should be unable to deliver its nuclear bomb to a target, for example, provisions must be made either for the plane to return to its base carrying a live bomb or to dump an extremely expensive weapon over an uninhabited area. "Not only must

weapons be capable of being shipped by truck, airplane, railroad car, and ship, but also they must have built-in safety features which insure that accidental nuclear detonations do not occur, even under unexpected emergency conditions such as fire or airplane crash."

Mr. Martin also pointed out that, with more atomic weapons being designed for use by troops in the field, designers must take into account the fact that they may be handled by comparatively inexperienced personnel. Engineers also concern themselves with the locations and climates in which weapons may be assembled and tested, methods of shipping and inspection, effects of high altitude, and other factors.

Despite many elaborate tests and intricate safety devices designed to produce the safest and most reliable weapons possible, Mr. Martin added, the designers of nuclear devices "have occasionally arrived at the conclusion that the best, single, over-all test to insure that our nuclear weapons will remain operative under all conditions is to give one to the average GI with the instruction, 'be careful of this.'"

Captain Richard S. Mandelkorn of the U. S. Radiological Defense Laboratory, San Francisco, Calif., presided.

Banquet

This year's guests at the Semi-Annual Meeting Banquet witnessed a dramatic series of events. Held on Wednesday evening, the program, with J. Calvin Brown, past-president and Fellow ASME, acting as toastmaster, included the announcement of the winner of the Student Competitions for the 1957 Old Guard Prize, the results of the Nominating Committee for next year's President and other Officers, the announcement of the retirement of C. E. Davies as Secretary of ASME, and an address by H. Rowan Gaither, Jr., chairman of the board, The Ford Foundation, and chairman of the board, The Rand Corporation.

ASME Secretary Davies described the Student Member Competition as one of the most important events of the Society. At each Semi-Annual Meeting the winners of each of the 12 Regional Student Conferences compete for the 1957 Old Guard Prize which includes a cash prize, a certificate, and a trip to the 1957 Annual Meeting in New York. The winner of this year's competition, held earlier in the day, was George M. Reynolds of Northwestern University, Evanston, Ill. (Region VI, Southern Tier), for his paper "Computer Control of Machine Tools." Mr. Reynolds will also present his paper during the Annual Meeting.

The following papers, which provided stiff competition for Mr. Reynolds, were also entered in the contest:

"Fusion," by Philip A. Thompson, Rensselaer Polytechnic Institute, Troy, N. Y. (Region I).

"Hazards Associated With the Use of Radioisotopes in Nondestructive Testing Techniques," by Robert D. Martin, Polytechnic Institute of Brooklyn, Brooklyn, N. Y. (Region II).

"Reproducible Low Impact Testing," by William J. Murphy, Villanova University, Villanova, Pa. (Region III).

"Application of Gas Turbines to Automobiles," Gilbert B. Ballard, Jr., Alabama Polytechnic Institute, Auburn, Ala. (Region IV).

"The Effect of Mechanical Engineering on Resistor Board Development," by Matthew T. Orvik, University of North Dakota, Grand Forks, N. Dak. (Region VI, Northern Tier).

"Has the Engineer By-Passed Education?" by Albert V. Ferris, University of Dayton, Ohio (Region V).

"The Martin Baker Ejection Seat MKCF2," by John R. M. Gordon, University of British Columbia, Vancouver, British Columbia, Canada (Region VII, Pacific NW).

"Design and Test Operation of a Hydrofoil," by John M. Bristol, Jr., University of Santa Clara, Santa Clara, Calif. (Region VII, Pacific SW).

"Nuclear Thermo-Electro Power," by Larry A. Rash, Kansas State College, Manhattan, Kan. (Region VIII, Northern).

"Aviation Oxygen Requirements and Equipment," by Carey E. Murphey, Jr., University of Texas, Austin, Texas (Region VIII, Southern).

"A Pure Reaction Gas Turbine," by Daryl R. Schwichtenberg, South Dakota School of Mines, Rapid City, S. Dak. (Region VIII, Rocky Mountain).

Mr. Davies then gave the report of the Nominating Committee for next year's slate of ASME officers.

James N. Landis, vice-president of Bechtel Corporation, was nominated for President of ASME.

Also nominated to the posts of regional vice-presidents and directors were:

Charles E. Crede, vice-president, Berry Controls, Inc., Watertown, Mass., Vice-President, Region I.

Arthur W. Weber, vice-president, Corning Glass Works, Corning, N. Y., Vice-President, Region III.

Ernst W. Allardt, chief engineer, The Babcock & Wilcox Co., Tubular Products Division, Alliance, Ohio, Vice-President, Region V.

Henry S. Aurand, Lieutenant General, U. S. Army, Ret., Honolulu, Territory of Hawaii, Vice-President, Region VII.

L. N. Rowley, Jr., executive editor, *Power*, McGraw-Hill Publishing Company, New York, N. Y., Director—Administrative Activities.

Elmer O. Bergman, staff consultant, C. F. Braun & Company, Alhambra, Calif., Director—Codes and Standards.

Ronald B. Smith, vice-president, The M. W. Kellogg Company, New York, N. Y., Director—Technological Activities.

Detailed biographical data on the nominees are published elsewhere in this issue.

One event that hasn't occurred very often in the annals of ASME is the retiring of a Secretary. It was therefore of historical significance when C. E. Davies, Secretary of ASME since 1934, announced his retirement, effective at the end of this year, during the banquet proceedings. He also announced that O. B. Schier, 2nd, has been designated Secretary-Elect of ASME by unanimous vote of the ASME Council.

Mr. Gaither, principal speaker at the banquet, pictured tomorrow's world as a place where man will be able to control the climate and the weather, where there will be limitless sources of energy, and electronic translating machines will simplify communications between nations.

He cautioned, however, that the power of destruction inherent in nuclear energy must be controlled "if mankind's power to progress is to be exercised."

Mr. Gaither said that the social sciences, in coming years, will benefit by technological progress, pointing out that the mathematics developed for describing computing processes and the computers themselves may be applied to problems of the social scientist.

After predicting that man will some day be able to eliminate all known diseases, as well as others not yet recognized, that world-wide television networks would be produced, that space travel will become a reality, Mr. Gaither said, "There really is nothing Buck Rogers about any of this. What seemed improbable fantasy 25 years ago is today a commonplace."

The theme of Mr. Gaither's speech to the engineers was a plea for what he called "constructive dreaming."

Citing impressions he had gained during a recent trip through much of Asia, Mr. Gaither said that the growing demand for a better life by Asian peoples, sometimes called Asian Nationalism, "is not just nationalism identified with national governments or national commitments," but is a "universal ferment" in the area. He called upon his audience

Engineering problems facing industry, nuclear energy safety, materials for high-speed aircraft, biotechnology, solar energy for practical uses, among topics discussed

William J. Harris, *left photo,* of the National Academy of Sciences, gives some facts and figures on the current status of titanium and steel sheet materials during an Aviation Division technical session

In *right photo,* group listens attentively as various aspects of the engineering test reactor were disclosed at a Nuclear Engineering session. Coolant systems, shielding, design, and construction costs were presented.

to apply more effectively the new technical knowledge being gained each day, adding that there is a danger that in the underdeveloped countries, "Demands and expectations can outstrip available trained human resources and available natural resources." Disillusionment stemming from this situation in turn can "produce political chaos," leading to war.

While neither was present at the banquet, Howard L. Bodwell of La Jolla, Calif., and Stewart M. Marshall of Palo Alto, Calif., were recognized as "Fifty-Year Members of ASME."

Consulting Engineers' Luncheon

It is well recognized that given the broad outlines of concept, engineering is aggressive in prosecuting the design and execution. It is our progressional obligation to overcome the obstacles of nature and to harness the physical forces that affect our assigned project, but physical measures are not the complete yardstick by which the real cost or value to the ultimate "client" is truly evaluated. So said Col. John P. Buehler, executive engineer, Bechtel Corporation, the featured speaker at the Consulting Engineers' Luncheon on Thursday.

"It often happens" he pointed out, "that proposals for bridges, highways, freeways, and even large multipurpose dams and the like are exhaustively discussed in public assemblies, public hearings, and in the press, with emotions or special interests dominant, while engineers, who have extraordinary knowledge and could contribute, remain silent. I do not propose that the profession should become vocal or partisan merely for the sake of being recognized and heard, but where relative physical facts have a distinct bearing on the ultimate costs and benefits to society, we are remiss in remaining silent and have not discharged our full obligation nor offered our full potential contribution to obtain the best solution.

"There is no reason why engineers should fear or avoid taking such an active part in management and public affairs, and people respect those who have, and offer good ideas. By such acts of constructive contributions our profession will increase in stature and public recognition. In substance, the way to improve our professional status is not to avoid the public, but to join with them and demonstrate by practical teamwork the engineer's early value to the effective and economical application of resources to any development."

Warren H. McBryde, past-president and Fellow ASME and a San Francisco consulting engineer, presided.

Technical Program High Lights

Technical topics which were presented at the 48 sessions through some 130 papers included the latest information in a wide number of fields of mechanical engineering. Highlights from some of the papers follow:

Aviation. How Convair solved the problems involved in design of cabin doors for its "800" jet transport airplane was described. The result is a lightweight plug-type door which affords maximum safety and ease of operation. In addition to being light in weight and extremely safe, the door is easy to install and adjust, and requires a relatively small fuselage cutout.

Solutions to two of the knottiest problems facing aircraft designers, landing gear and aerial refueling units, were suggested by another paper. It revealed that a new type of landing gear has been developed for heavy Air Force cargo

planes with a gross weight close to 100,000 lb. Instead of the conventional arrangement, the new device features two wheels, one in front of another, as on a bicycle, on each side of the aircraft. This tandem arrangement promises several advantages including improved reliability, smaller concentration of weight on the runway, and a narrower housing when the wheels are retracted.

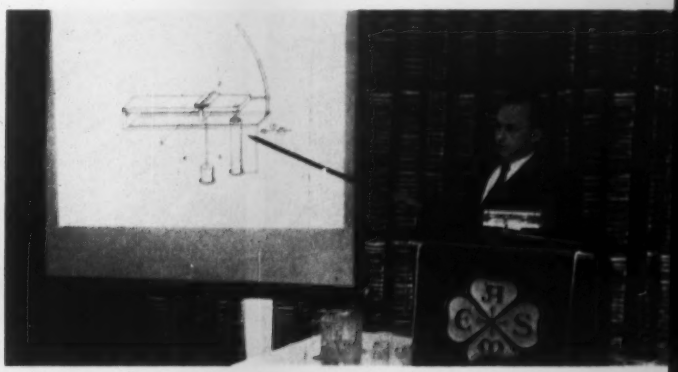
At the same session, methods used to develop America's most modern aerial refueling devices were described. The new units are said to permit fighters and bombers to refuel rapidly at higher altitudes and higher speeds than ever before.

light in weight. Use of such materials, however, will require new manufacturing methods, since the new alloys are much more difficult to shape into usable forms than today's metals.

It was also pointed out that although tomorrow's airplanes may be made largely of these super alloys there will also be a need for heat-resistant transparent plastics, paints, lubricants, insulators, and other nonmetallic materials. However, the development of essential new materials and ways to use them will depend on the "continued support of government-sponsored research and the ingenuity of free enterprise in this country." In addition to mechanical construction, engineers are considering the problem of protecting pilots from the intense heat of "thermal" aircraft.

which are difficult to include in experiments, such as individual health, perspiration, and blood circulation, must be borne in mind when considering the results. It was also pointed out that it is difficult to secure enough reliable experimental information at extreme temperatures, since reports of individuals who survive extreme heat or cold, such as those who escape from burning buildings, usually do not provide detailed information on temperatures or other conditions.

Reporting on the effect of high temperatures on human performance, the paper described experiments in a Link



Design for thermal flight was discussed by group in *left photo.* Shown *left* to *right* are: George Gerard, New York University; Joseph W. Semonian and Robert F. Crawford, Aerophysics Development Corporation; and Edward A. Simkovich, Republic Aviation Corporation. A flat surface friction apparatus, *right photo,* is described during a joint Metals Processing-Metals Engineering-Machine Design session by E. J. Weiter of Marquette University.

A "disassembly line," or assembly-line-in-reverse, used to take apart airplane engines in need of repair, was described to engineers seeking ways to use automatic techniques to cut the cost of aircraft maintenance. Another speaker called for construction of special trouble-shooting machines which would enable mechanics to find out what is wrong with an engine without removing it from the aircraft. The development of "engine analyzers" which could diagnose ailing engines, or spot potential trouble, thereby cutting costs, was called for.

The aircraft industry also got a preview of the revolution in manufacturing methods that will be required to construct airplanes capable of breaking the "thermal barrier." Speakers at the meeting predicted that tomorrow's aircraft, flying so fast that friction with the air will heat them to temperatures of 1200 F or higher, will have to be made by "completely new manufacturing methods" out of materials only now being developed. New alloys of titanium and steel are now being developed which are relatively immune to heat and are fairly

Heat Transfer. How much heat can a human being stand before suffering a nervous breakdown? This question, critically important to engineers designing aircraft so fast that they are heated by friction with the air, was answered in a paper on "biotechnology"—one of a group of papers in which medical experts and researchers from other fields revealed their research results on what happens to humans exposed to extreme heat, cold, or radiation such as that encountered in outer space.

Safe exposure time for a man at various temperatures was disclosed. Figures indicate that under specified conditions a man covered with one centimeter of clothing might remain as long as a minute and a half in air at 900 F without collapse. Without protective clothing he might survive a 300-deg temperature for the same period.

It was cautioned that many factors

trainer, a device in which student pilots practice handling simulated aircraft control while their actions are recorded by instruments. In experiments at temperatures between 120 and 235 F, the performance of student pilots was near normal for about three quarters of the safe exposure time for a given temperature. During the last quarter of exposure time, experimenters noted a rapid increase in dizziness, faintness, mental confusion, nausea, and other symptoms, followed by a sharp increase in the number of errors in handling the controls.

Metals Engineering. A new industrial technique, vacuum metallurgy, is transforming ancient methods of working with metals and giving engineers an important new tool in their efforts to produce faster aircraft, nuclear power, and new chemicals. The vacuum process, although it has some commercial applications today, has even more potential for the future, according to one of the meeting papers. Vacuum metallurgy is used in working with certain metals that ordinarily combine with gases from the air when heated. By

surrounding the hot metal with a vacuum, the unwanted reactions can be eliminated. This makes it possible to manufacture products not achievable in any other way.

Air Pollution. A professor called for all power-plant operators to pool their resources in a fight on smog. He said that no matter what air-pollution control processes are developed they will be expensive, but that demand for more complete control of industrial smoke will undoubtedly continue to increase. This situation calls for co-operation between all power-producing agencies, and the results achieved recently in Pittsburgh, Pa., were cited when a group of industries joined to reduce air pollution in that city. He added that in Los Angeles, Calif., the activities of a Joint Research Council on Power Plant Air Pollution are a step in the right direction. Recommendations contained in this paper were based on an analysis of the causes of smog and a review of techniques used to reduce it, including various methods of removing irritating oxides of nitrogen and sulfur compounds from smokestack gases.

The paper pointed out that the initial cost of smoke-control equipment is high, often running to millions of dollars, and that, even if usable by-products are obtained from waste gases, the costs of operation are also high. In addition, if many industries start to produce and sell the same by-products, their price is likely to fall, thereby increasing the over-all cost of smoke control still further.

Wood Industries. A special program on problems of the wood and lumber industry, with particular attention to the Northwest States, was included in the program. An all-day session dealt with current developments such as methods of efficiently converting waste sawdust and woodchips into useful products, remote control systems for sawmill carriages—which completely eliminate the need for an operator of the carriage—and modern techniques of scientific forest management and conservation.

Materials Handling. A sturdy wooden box called a container, approximately 6 ft high, 4 ft wide, and 6 ft deep, represents the most promising innovation in the world-wide shipping industry. Reporting on a three-year study at U.C.L.A., a paper described a revolutionary system of "containerizing" general cargo. It was pointed out that presently dry cargo of all shapes and sizes is loaded piece by piece on a pallet. The pallet is then lifted by a ship's boom and lowered in the hold where the cargo is unloaded piece by piece. The use of standardized containers would serve to homogenize the odd assortment of cargo, and the number of times individual cargo items would have to be handled would be greatly reduced thereby speeding up the entire loading operation.

"Moving day 1960" may find your furniture and household belongings "canned" in aluminum containers. So stated another materials-handling consulting engineer, as he outlined some of the past and future prospects in the "containerization" field. He discussed the need for standard shipping container sizes so that containers may be interchanged between various transportation carriers.

"Moving a houseful of furniture from Decatur, Ill., to Berlin, Germany, is plausible today with but one packing operation," he said, "provided the belongings are loaded into standard-sized shipping containers."

Most of the uses for shipping containers today, however, are for moving commercial goods by public carriers. Containers have been standardized mostly for limited interchanges, since there are no standard sizes applicable to all types of carriers.

According to the speaker, in the interest of efficiency, several standard sizes should be adopted. Using any one of these standard designs, goods may be moved anywhere in the world with but one loading job.

Advantages of shipping containers far outweigh drawbacks. Among the former are: Shipment in undisturbed sealed units; reduced packing costs; reduction in labor, time, and cost in loading, stowing, and unloading carriers; less physical damage and breakage; reduction of contamination; and reduction of pilferage.

The development and design of the Lockheed C-130 landing gear were reviewed by R. O. Dickinson, Jr., *left photo,* of Lockheed Aircraft Corporation at a joint Aviation-Machine Design Session. In *right photo,* Roy V. Wright Lecturer George L. Sullivan, *right,* receives lectureship certificate from ASME President W. F. Ryan, *left.*

Nuclear Power. Preliminary operation of America's first full-sized atomic plant "is proceeding satisfactorily and is expected to continue in the same manner," engineers attending a nuclear session were told. Preliminary engineering tests at the Shippingport Atomic Power Station near Pittsburgh, which is expected to begin producing usable power later this year, were described. A four-stage program now being carried out will insure that the station will operate satisfactorily when the nuclear fuel is inserted. The program includes inspection of installed equipment, testing of key parts, and preliminary operation to be certain that the station is capable of carrying a full load.

The main roadblock to England's ambitious plans for creating a gigantic nuclear power industry within the next 20 years is not a shortage of technical knowledge as has sometimes been suggested, but a scarcity of trained personnel. A British engineer denied that atomic power stations built in Britain today are inefficient and would soon be obsolete, as has been contended by some experts.

Conceding that demand for coal and oil in Britain will soon exceed the available supply, and that this situation calls for rapid development of nuclear power for industrial use, he said that the present British program "is by no means a stop-gap adopted by a country with a dire shortage of conventional fuels."

Contrast between Great Britain's plans for rapid development of peacetime atomic power, and America's slower, more cautious approach, has led to a sharp difference of opinion in this country. Defenders of American policy have frequently said that, although nu-

clear power generation may be economically feasible in England, knowledge of atomic plants is not sufficiently advanced to justify large-scale construction in America of units that may rapidly become outmoded.

The speaker gave a different view, saying that plants of the current British type, with possible improvements, will still be built 25 years from now. He added that the power reactor now in operation at Calder Hall, in England, has advantages of simplicity and safety that are not inherent in more advanced types. Calder Hall has operated in a trouble-free manner, he said, and "present indications are that the expectations of designers will be fully met."

Another paper covered problems in designing, building, and operating the Army's first nuclear power reactor. The engineering and technological roadblocks that had to be surmounted before the Army Package Power Reactor was opened at Fort Belvoir, Va., in April were described.

Two contrasting sides of the atomic energy picture—one bright, one gloomy—also were outlined.

On the bright side: The cost of electric power generated by the atom is almost certain to be reduced drastically in coming years. Many parts of the world, including Western Europe, already find nuclear energy an economic boon. The United States will probably be using competitive atomic power in a decade or so.

On the gloomy side, members heard an extended discussion of the problems of decontaminating an area that has been dusted with radioactive fallout from a bomb or from a nuclear accident. The enormous efforts that would be required to remove radioactivity from a city after atomic attack were described.

Solar Energy. The world's first solar-heated office building, located at Albuquerque, N. Mex., survived its initial winter trials "satisfactorily," it was revealed. In a technical session dealing with methods of using the sun's heat for practical purpose, three New Mexico engineers said that a system installed in their own offices last year "performed satisfactorily through the worst part of the winter including a much cloudier than normal January." See MECHANICAL ENGINEERING, June, 1957, p. 536.

American Rocket Society. Liquid rockets, ramjets, solid rockets, hypervelocity flight, instrumentation and guidance, and space flight were among the topics covered during the Semi-Annual Meeting of the American Rocket Society. An affiliate of ASME, ARS held its meeting concurrently with the ASME Semi-Annual Meeting, June 10–13, in San Francisco. The ARS meeting was headquartered at the St. Francis Hotel. Nearly 700 rocket and guided-missile experts were in attendance.

In addition, exhibits of companies located in the Northern California and Sacramento Sections were on display on June 11 and 12.

The Navy's top ballistic missile man, Rear Admiral William F. Raborn, USN, director of the Bureau of Ordnance's Special Projects Office, was the principal speaker at the banquet on June 11. Dan A. Kimball, former Secretary of the Navy and now president of Aerojet-General Corporation, Azusa, Calif., addressed luncheon meeting the same day.

Meeting activities ended on Thursday afternoon, June 13, with a guided tour of the Ames Aeronautical Laboratory at nearby Moffett Field.

Papers Available. A complete list of the available ASME papers presented at the meeting may be found on pages 778–780 in this issue. In addition, digests of numbered Semi-Annual papers have appeared in the July issue of MECHANICAL ENGINEERING. Digests of the remaining papers will appear in this and subsequent issues.

Wright Lecture

George L. Sullivan, dean-emeritus of the college of engineering of the University of Santa Clara, called upon his fellow engineers to enter the arena of politics in order to help assure an adequate supply of water for the State of California. Dr. Sullivan said that current plans for developing a state water supply are blocked by partisan political wrangling, but that "if engineers had more influence in the California legislature, the California water plan would have a much better chance of bringing the water which is wasting down the Sacramento River to the valleys where it is needed."

Dr. Sullivan's remarks were contained in his Roy V. Wright Lecture which was named in honor of a past-president of ASME who frequently urged members of the engineering profession to become more active in civil affairs.

ASME President Ryan presided at the lecture.

"When an adequate water project is in operation," Dr. Sullivan said, "the vast central part of California will be a paradise of growing crops instead of a semi-arid region of ghost towns." He cautioned, however, that technical excellence of the plan would not be enough, because "factions in the northern and southern parts of the state refuse to allow progress unless their own areas get just what they want."

ASME Officers Nominated for 1958

MEMBERS of the ASME Nominating Committee for 1957, E. H. Hanhart, *chairman;* R. H. Stockard, secretary; S. L. Grapnel, H. F. J. Skarbek, T. J. Judge, J. F. Cunningham, Jr., G. H. Frost, W. A. Biddle, R. W. Cox, Otto de Lorenzi, and H. N. Blackmon, have nominated for 1958 the following:

Office	*Nominee*
President	James Noble Landis
Vice-President (for two years)	C. E. Crede, Region I, renominated
	A. W. Weber, Region III
	E. W. Allardt, Region V
	H. S. Aurand, Region VII
Directors	
Technology	R. B. Smith, four years
Codes and Standards	E. O. Bergman, four years, renominated
Administrative	L. N. Rowley, Jr., four years

Biographical sketches of the candidates for office appear elsewhere in this issue of MECHANICAL ENGINEERING.

Urging participation in government by engineers, he said they could exert a powerful influence for integrity and honesty in government by actively supporting worthy candidates or running for office themselves. He added that "the self-seeker and the crook love to see inactive citizens. Today, engineers as a group are not civic-minded. They are too much wrapped up in their designs and forget that the ineptitude of government may cause their finest designs to be perverted to the destruction of mankind."

Business Meeting

At the Business Meeting of the Society, held June 10, 1957, during the Semi-Annual Meeting the following announcements were made:

The 1958 Semi-Annual Meeting will be held in Detroit, Mich., June 15 through 19, at the Hotel Statler.

The personnel constituting the 1958 Nominating Committee was recorded. (See page 821 of this issue.—Editor.)

Plant Trips and Excursions

The plant trips in and around San Francisco were of such a nature that they combined inspection of facilities in general use by industry and sight-seeing excursions in some very beautiful country.

The first trip on Tuesday was a most interesting example of this combination. The visitors were taken to see the San Joaquin plant of Fibreboard Products, Inc. There for practical purposes they followed the path of the raw wood from the moment it enters until it emerges as paperboard. The debarking operation of huge logs and chipping process which reduces these logs to splinters in a matter of moments was shown as well as the entire operation through the production of the finished paperboard and its conversion into milk cartons.

After luncheon at Riverview Lodge in Antioch, the group visited Crown-Zellerbach Corporation's plant and viewed the manufacture of kraft paper and linerboard, and a converting operation for the manufacture of multiwall bags. One factor of interest in Crown-Zellerbach's operation is the revolutionary development for the shipment of kraft pulp, manufactured in British Columbia, to the mill at Antioch via a pulp tanker. Upon the arrival of the tanker, the pulp is pumped from the tanker, thickened, and conveyed to an open storage basin for use as required by the paper machine. This plant has one Fourdrinier-type paper machine with a wire width of 260 ft with a potential output of 600 tons a day. The converting operation showed the manner in which commercial-type multiwall bags are formed and made ready for use.

Some visitors took advantage of the opportunity to see the Pittsburg and Contra Costa Power Houses of the Pacific Gas and Electric Company as well.

In the afternoon, of those who stayed in town for morning sessions, a group was taken to the San Francisco Naval Shipyard, one of the most colorful and capable of its kind in the United States, and where the Nation's only laboratory devoted to defense against effects of atomic weapons is located. A tour of the waterfront was included with stops to view berthed ships, the dry docks, and one of the world's mightiest cranes with a lift of 630 tons.

The one trip on Wednesday was devoted to the inspection of the United Airlines Maintenance Base. The base is located adjacent to the International Airport and is United's main repair center. Here the visitors were shown the complete facilities for repairing giant airliners, including complete engine overhaul.

Three excellent trips were scheduled on Thursday. The trip to the Ames Aeronautical Laboratory, one of the facilities of the National Advisory Committee for Aeronautics, at Moffet Field, Calif., offered the visitors an opportunity to inspect the supersonic and hypersonic wind tunnels.

Later in the day a group was taken on a tour through General Electric's Vallecitos Atomic Laboratory, Pleasanton, Calif. Here they saw the laboratory and other points of interest.

At 4:00 that afternoon a large group took off for Yosemite National Park, returning on Saturday afternoon. This sight-seeing excursion revealed the many wonders of nature to be seen only in Yosemite Valley. They were taken to see the wondrous gorge, world renowned for Half Dome, El Capitan, and other lofty peaks, and for the breathtakingly beautiful Yosemite Falls, with a total drop of almost one-half mile.

ASME group takes time out during tour of San Francisco Naval Shipyard

ASME members at a repair station at United

Women's Program

The women who joined their husbands at the Semi-Annual Meeting had the red carpet rolled out for them in no uncertain terms. If any of the visitors missed a single point of interest, the fault was her own. The planned program went something like this:

On Sunday, the early arrivals were greeted by members of the San Francisco Section and their wives at a Western Welcome Reception tea and cocktail party which was followed by a scenic presentation by the Photographic Committee. The guests were shown slides and scenic motion pictures of San Francisco and vicinity. Additional slides of technical interest to photographers were also shown.

Monday started early with a coffee hour so that the hostess and guests could marshall their plans for the day, and what a day it was. There was a

choice of one of three luncheons—it was a difficult decision. First, there was the possibility of luncheon on the Starlight Roof of the Sir Francis Drake Hotel and shopping at such internationally famous shops as Gumps, Podesta Baldocchi, several in Union Square and Maiden Lane. Or, as several did, go to the Capri Room of Sabella's Restaurant on Fisherman's Wharf followed by a sight-seeing boat tour of the bay. Or, finally, the one that transported the visitors to another world—luncheon at Johnny Kan's Restaurant in the heart of San Francisco's authentic Chinatown. Afterward the group was taken on a walking tour of Chinatown shops, the Buddhist Temple, and St. Mary's Roman Catholic Church.

Airlines Maintenance Base

Early Tuesday morning after a coffee hour the women embarked on a sight-seeing tour of this most unusual city which included such points of interest as Coit Tower, Marina and Yacht Harbor, Twin Peaks, Golden Gate Park, and many others too numerous to mention. That day the women went to the Cliff House, overlooking Seal Rock, for luncheon.

Having exhausted the sights in San Francisco, on Wednesday, the women journeyed to Stanford for new worlds to conquer. They took the skyline to Stanford University, touring the campus and stopping to see the Stanford Chapel; had luncheon at Allied Arts Guild with time later to browse in the garden and shops. The afternoon wound up with a visit to Sunset House, home of *Sunset*, the magazine of western living and gardens. In the evening there was a Social Hour and the Banquet of the Semi-Annual Meeting.

Thursday was devoted to a three-bridges tour of the scenic wonders of the San Francisco Bay Area. This group took off at 10:00 a.m. First crossing the Bay Bridge to Oakland, they saw Treasure Island, site of the last San Francisco World's Fair, now an installation of the Twelfth Naval District. They had brunch at the Claremont Hotel in Berkeley and enjoyed the panoramic views and magnificent gardens. They then saw the University of California campus and drove across San Pablo Bridge to Muir Woods noted for the Sequoia Redwood Grove. Late in the afternoon they returned to San Francisco via the renowned Golden Gate Bridge.

The last day of the meeting—the women were veteran sightseers by this time—they took off on an all-day tour of the Valley of the Moon country. In air-conditioned buses, their travels took them through Sonoma County; they had a barbecue luncheon at the Beringer Winery in St. Helena, and barrels of fun going through the winery. They came home tired, but full of the wonders of California.

Committees in Charge

ASME meetings come under the general supervision of the Meetings Committee.

The technical program is provided by the Society's professional divisions and technical committees. Other features are planned and supervised by committees organized within the host section—in this case the San Francisco Section. In grateful acknowledgment of the many committees whose efforts contributed so substantially to the success of the 1957 Semi-Annual Meeting their personnel is listed as follows: *Meetings Committee:* C. W. Parsons, *chairman;* G. R. Fryling, W. B. Wilkins, A. M. Gompf, and H. N. Muller, Jr.

San Francisco Section: A. K. Ingraham, *chairman;* R. A. Bowman, *vice-chairman;* E. G. Chilton, secretary-treasurer.

General Arrangements Committee: J. N. Landis, *chairman;* V. F. Estcourt, Alf Hansen, Leonard D'Ooge, Sacramento Subsection, and G. F. Gayer, Santa Clara Subsection, *advisors*.

Reception Committee: W. H. McBryde, *chairman;* Robert Sibley, O. B. Lyman, G. L. Sullivan, K. B. Anderson, G. H. Raitt, V. F. Estcourt, H. T. Avery, G. N. Somervill, F. T. Letchfield, W. H. Kassebohm, Alf Hansen, M. P. O'Brien, A. G. Cattaneo, J. A. Campbell, R. L. Inglehart, H. A. Johnson, R. L. Johnson, G. S. Drysdale, F. W. Beichley, and A. K. Ingraham.

Finance Committee: T. W. Bean, *chairman;* E. T. Barnett, R. S. Chamberlin, G. S. Clark, R. E. Grady, and N. B. Shumate.

Registration and Information Committee: K. B. Anderson, *chairman;* B. S. Truett, *vice-chairman;* R. E. Brakeman, Jr., J. R. Edmund, E. C. Floyd, G. A. Hansen, Regnar Hessellund, T. A. Rohrer, C. E. Sommarstrom, and C. J. Tateosian.

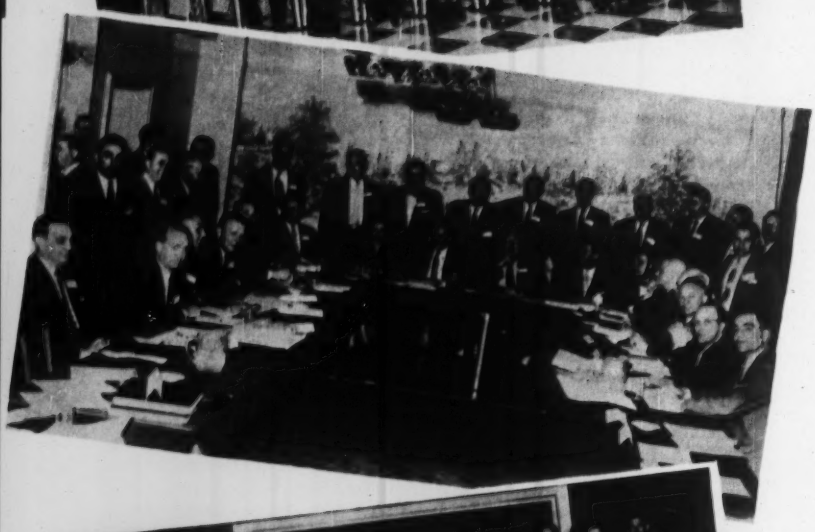
Technical Events Committee: F. W. Beichley, *chairman;* D. R. Schumacher, *vice-chairman;* H. A. Altorfer, B. W. O. Dickinson, 3rd, P. E. Holden, E. D. Howe, F. H. Meyers, R. F. Steidel, Jr., and T. S. Voorheis.

Entertainment Committee: R. D. Spear, *chairman;* J. E. Barker, H. J. Bentson, F. H. Meyers, W. H. Ness, and C. C. Whelchel.

Photographic Committee: T. H. Smith, *chairman*, A. H. F. Barlow, G. C. Barnaby, W. D. Elston, G. A. Hansen, S. I. Heisler, Robert Lenquist, C. N. Maxfield, W. J. Osborn, J. P. Van Overveen, and M. W. Wangsness.

Publicity Committee: E. C. Maund, *chairman;* N. P. Campbell, E. H. Casson, J. F. Stannard, Jr., and R. R. Thompson.

Women's Committee: Mrs. W. H. McBryde, *honorary chairman;* Mrs. J. N. Landis, *general chairman; Registration and Hospitality*, Mrs. C. D. Allen; *Coffee Hours*, Mrs. G. R. Gayer; *Monday Luncheons and Tours*, Mrs. G. A. Hansen; Mrs. H. A. Altorfer, Mrs. L. D. Barter, Mrs. T. W. Bean, Mrs. H. F. Brush, Mrs. L. R. Burmester, Mrs A. K. Ingraham, Mrs. J. R. Kiely, and Mrs. F. F. Mautz; *Tuesday City Tour*, Mrs. K. K. Knopf; *Peninsula Tour*, Mrs. T. H. Smith; *Three-Bridges Tour*, Mrs. H. J. Bentson; Mrs. Edward Norbeck, Mrs. J. H. Olson, Mrs. G. E. Peterson, Mrs. H. C. Reichard, Mrs. J. P. Van Overveen, Mrs. R. L. Walker, Mrs. G. L. Way, and Mrs. C. C. Whelchel.



DURING March, April, and May of this year the eight Regional Administrative Committees of The American Society of Mechanical Engineers met to discuss with the Vice-Presidents, various Regional and Society problems; to express Regional views on the National Agenda; and to provide representatives of Sections an opportunity to further the nominating procedure for national offices.

The present procedures have evolved from long experience with various methods of bringing representatives of the Sections together. Delegates from Sections first met at the 1915 Spring Meeting in Buffalo, N. Y.—two representatives coming from each of the 15 Sections.

The Annual Conference started originally in 1916 and continued until 1951. The Sections had previously been grouped into seven groups for the purpose of selecting members of the Society Nominating Committee, and in 1932 the Annual Conference was replaced by seven regional conferences using the same grouping used for Nominating Committee selection. A single delegate from each region attended a conference at the An-

nual Meeting. In 1935 the delegates from the regions were increased to two each, each serving overlapping terms of two years, and the Annual Conference was moved to the Semi-Annual Meeting.

In 1940 the number of regions was increased to eight. The following year the Vice-Presidents were assigned regional responsibilities and the present Regional Administrative Committees came into being, made up of two representatives of each Section. At the same time the Regional Delegates Conference was formalized

The RAC meetings are held each year during March, April, or May. The place is decided at the proceeding RAC meeting or by the Vice-President. The date is arranged among the Vice-Presidents, the Host Section, and the Secretary's office, and confirmed at a meeting of Vice-Presidents.

A report on the 1957 Regional Delegates Conference, held during the ASME Semi-Annual Meeting in San Francisco, Calif., June 9–13, at the Sheraton Palace Hotel, will appear in a forthcoming issue of MECHANICAL ENGINEERING.

The eight ASME Regional Administrative Committees convened in their respective regions to discuss regional and Society problems and other topics of interest. Shown *clockwise,* are Region I, Bridgeport, Conn., May 3–4; Region II, New York, N. Y., May 1–2; Region III, Rochester, N. Y., April 11–12; Region IV, Birmingham, Ala., April 6–7; Region V, Toledo, Ohio, April 29–30; Region VI, Peoria, Ill., March 29–30; Region VII, Richland, Wash., April 19–20; and Region VIII, Mexico City, Mexico, April 4–5.

Regional Administrative Committees

ASME Coming Events

August 11–15
ASME-AIChE Heat Transfer Conference, Pennsylvania State University, University Park, Pa.

Sept. 22–25
ASME Petroleum Mechanical-Engineering Conference, Hotel Mayo, Tulsa, Okla.

Sept. 23–25
ASME Fall Meeting, Hotel Statler, Hartford, Conn.

Oct. 7–9
ASLE-ASME Lubricating Conference, concurrently with ASME-IMechE International Conference on Lubrication and Wear, Royal York Hotel, Toronto, Ont., Canada

Oct. 8–12
ASME-AIME Fuels Conference, Chateau Frontenac, Quebec, Que., Can.

Oct. 21–23
ASME Power Conference, Americus Hotel, Allentown, Pa.

Dec. 1–6
ASME Annual Meeting, Hotel Statler, New York, N. Y.

March 3–6, 1958
ASME Gas Turbine Power Conference and Exhibit, Shoreham Hotel, Washington, D. C.

March 16–20, 1958
Nuclear Congress, International Amphitheater, Chicago, Ill.

March 17–20, 1958
ASME Aviation Conference, Hotel Statler-Hilton, Dallas, Tex.

March 19–20, 1958
ASME Engineering Management Conference, Somerset Hotel, Boston, Mass.

April 1–3, 1958
ASME Instruments and Regulators Conference, University of Delaware, Newark, Del.

April 9–10, 1958
ASME Railroad Conference, Hotel Statler, Cleveland, Ohio

April 14–15, 1958
ASME Plant Maintenance Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

April 14–17, 1958
ASME Design Engineering Conference, International Amphitheater, Chicago, Ill.

April 24–25, 1958
ASME Management-SAM Conference, Hotel Statler, New York, N. Y.

May 18–22, 1958
ASME Oil and Gas Power Conference and Exhibit, Bellevue-Stratford Hotel, Philadelphia, Pa.

June 11–14, 1958
Third U. S. Congress of Theoretical and Applied Mechanics, Brown University, Providence, R. I.

June 15–19, 1958
ASME Semi-Annual Meeting, Hotel Statler, Detroit, Mich.

Note: Members wishing to prepare a paper for presentation at ASME national meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

ASME Appoints Two Assistant Secretaries

William E. Reaser has left the faculty of Engineering at Princeton University to accept appointment as Assistant Secretary of The American Society of Mechanical Engineers. Responsibilities of this office encompass the relations with the membership in the sections throughout the United States, Mexico, Canada, and Hawaii. An important phase of these activities is the work with students and recent graduates of the more than 140 American colleges and universities which have accredited mechanical-engineering curriculums.

Mr. Reaser was graduated from Lafayette College in 1930, and was awarded the MS degree by Lehigh University. In addition to considerable industrial experience, he taught engineering for a number of years at Lafayette College and Swarthmore College before joining the faculty of Princeton in 1952. He has been engaged as both an educational and industrial consultant.

As a member of ASME since 1935, his interests in Society affairs have been extensive, including participation in functions of technical groups and as a member of the Publications Committee, presently serving as its chairman.

John D. Wilding was recently appointed to the post of Assistant Secretary of the ASME.

Mr. Wilding, a member of the ASME staff since 1954, will be in charge of the Society's Codes and Standards Service, which co-ordinates the activities of more than 75 committees under ASME sponsorship engaged in preparing and revising codes and standards dealing with mechanical equipment of many kinds, including boilers, elevators, screws, and other items. He is a graduate of The Pennsylvania State University, where he received a BS degree in electrical engineering. Before joining the staff of ASME, he was a project engineer with M. W. Kellogg Company and served as a captain in the Signal Corps during World War II.

William E. Reaser appointed an assistant secretary, ASME, in charge of relations with the membership in the Sections

John D. Wilding newly appointed ASME assistant secretary in charge of the Society's Codes and Standards Service

Meetings of Other Societies

Aug. 12–15
Society of Automotive Engineers, Inc., national west coast meeting, Olympic Hotel, Seattle, Wash.

Aug. 19–21
1957 Cryogenic Engineering Conference, National Bureau of Standards, Boulder, Colo.

Aug. 25–27
American Association for the Advancement of Science, Pacific division, annual meeting, Stanford University, Stanford, Calif.

Aug. 28–30
American Institute of Electrical Engineers, Pacific general meeting, Pasco Senior H. S., Wash.

Aug. 28–Sept. 3
The Combustion Institute, seventh international symposium on combustion, The Royal Institute and Oxford University, England.

ASME OFFICERS *Nominated* for 1957-1958

James Noble Landis

Nominated for President

DURING the 1957 Semi-Annual Meeting of The American Society of Mechanical Engineers in San Francisco, Calif., June 9–14, James Noble Landis, vice-president, Bechtel Corporation, San Francisco, Calif., was nominated by the National Nominating Committee for the office of President of the Society for the year 1957–1958.

Regional Vice-Presidents named by the Committee to serve for a two-year term on the Council of ASME were: Charles E. Crede, renominated, Watertown, Mass., Region I; Arthur W. Weber, Corning, N. Y., Region III; Ernst W. Allardt, Alliance, Ohio, Region V; and Henry S. Aurand, Honolulu, T. H., Region VII.

Directors named by the Committee were the following: *Technology*, Ronald B. Smith, New York, N. Y., four years; *Codes and Standards*, Elmer O. Bergman, Alhambra, Calif., renominated, four years; and *Administrative*, Louis N. Rowley, Jr., New York, N. Y., four years.

Members of the Committee making the nominations were S. L. Grapnel, representing Region I; H. F. J. Skarbeck, Region II; E. H. Hanhart, Region III, *chairman;* T. J. Judge, Region IV; J. F. Cunningham, Jr., Region V; G. H. Frost, Region VI; W. A. Biddle, Region VII; R. W. Cox, Region VIII; Otto de Lorenzi, *Technology;* H. N. Blackmon, *Codes and Standards;* and R. H. Stockard, *Administrative secretary*.

Election of ASME Officers for 1957–1958 will be held by letter ballot for the entire membership, Sept. 26, 1957.

Biographical sketches of the nominees follow on the succeeding pages.

Nominated for President, 1957-1958

James Noble Landis

JAMES N. LANDIS, the presidential nominee for 1957-1958 of The American Society of Mechanical Engineers, is vice-president, Bechtel Corporation of San Francisco, Calif. For over 35 years he has been closely associated with power-plant engineering and construction. He was born August 18, 1899, in Champaign, Ill., a son of Earl McClay Landis and Agnes Hoisington Landis.

A graduate of Danville (Indiana) High School, he attended the University of Michigan at Ann Arbor, from which he was graduated in 1922 from the College of Engineering and Architecture with the degree of bachelor of science in mechanical engineering. He is a member of Tau Beta Pi, Sigma Xi, and a Fellow of ASME.

Before and after graduation from college, he was an instructor in mathematics at the University of Michigan. After a short period as a tool designer with Nordyke & Marmon, automobile manufacturers, in Indianapolis, he was employed as an engineer with the Engineering Department, Public Service Commission of Indiana. In June of 1923 he joined the Brooklyn Edison Company and served in various capacities, as technical assistant to mechanical engineer, research engineer, investigating engineer, and plant-equipment engineer, in connection with mechanical design, construction, and operational problems on the development of the Hudson Avenue Generating Station and other plants, assistant mechanical engineer administering the civil, structural, and mechanical engineering and layout for the Brooklyn Edison Company generation stations, offices, and yards. In March of 1932 he became the mechanical engineer of Brooklyn Edison Company, which position he held until 1936 when he was transferred to the parent company, Consolidated Edison Company of New York in charge of the newly forced contract control and inspection department for a year, and as assistant mechanical engineer for ten years. As assistant mechanical engineer he administered the civil and structural engineering, the mechanical-engineering design and layout, and electrical drafting, for all Consolidated Edison system power-plant installations, offices, and yards.

In July, 1948, Mr. Landis joined Bechtel Corporation of San Francisco, Calif., engineers and constructors, as chief power engineer in charge of engineering design and layout of steam-power plants. From January, 1953, when he was elected a vice-president of Bechtel Corporation to the present, he has been a consultant on engineering of power plants and associated with business development and client relationship activities. For the past several years he has been engaged in the activities of the Nuclear Power Group, composed of seven utility companies and Bechtel Corporation which has prepared numerous economic, design, and construction studies for nuclear power plants, and which has culminated in the design and construction of the Dresden Nuclear Power Station in Illinois.

Over a great many years Mr. Landis has been active in Society affairs, serving on many Standing and Special Council Committees through the years 1926 to date. After serving as chairman of the Metropolitan Section (1933–1935), he served seven years on the Local Sections Committee (1935–1942), where he developed an intimate acquaintance with Sections operations. He has been a member of the Executive Committees of both the Power Division and the Nuclear Engineering Division, having served as chairman (1945) of the Power Division, and chairman of the Subcommittee on By-Laws for the Nuclear Engineering Division (1955–1956). He was a member of the Finance Committee (1944–1945), Committee on Practice of Consulting Engineering (1953 to date), Director-at-large from December 1945 to December 1949, chairman of the San Francisco Section (1953–1954), honorary vice-president to the Fifth World Power Conference in Vienna, Austria, June 1956, and recently served as general chairman of the 1957 Semi-Annual Meeting in San Francisco.

He is a charter member of the American Nuclear Society, and a member of the Atomic Industrial Forum, Inc., Newcomen Society, the Engineers' Club of San Francisco, the Electric Club of San Francisco, the Armed Forces Chemical Association, and the Pacific Coast Electrical Association. He has long been active in the Prime Movers Committee of the Edison Electric Institute, and while with the Consolidated Edison Company, was a member of the Power Generation Committee of the Association of Edison Illuminating Companies. He is a licensed Professional Engineer in the states of California, New York, and Florida.

Mr. Landis is the author and coauthor of many technical papers which have been presented at various universities and to ASME meetings, as well as before the National Industrial Conference Board, the Pacific Coast Electrical Association, the National Association of Purchasing Agents, the American Gas Association, and the Fifth World Power Conference.

Nominated for Regional Vice-President To Serve Two-Year Term

Charles E. Crede

Arthur W. Weber

Charles E. Crede

CHARLES EDWIN CREDE, who has been renominated from Region I to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, was born May 4, 1913, at Wilkinsburg, Pa., and educated in the public schools of Wilkinsburg. He was graduated from Carnegie Institute of Technology in 1935 with the degree of bachelor of science in mechanical engineering. As a Tau Beta Pi Fellow, he attended the graduate school of the Massachusetts

Institute of Technology and received the degree of master of science in mechanical engineering in 1936.

His initial industrial experience was gained first as development engineer and later as assistant to the patent counsel, Standard Railway Equipment Manufacturing Company, New Kensington, Pa., and Hammond, Ind. At the beginning of World War II he entered the employ of the Navy Department as a civilian engineer in the Electrical Section of the Bureau of Ships in Washington, D. C. He worked on the development of means to protect shipborne equipment from the severe shock encountered in Naval warfare. In 1944 he was transferred to the Naval Research Laboratory to take charge of the organization of the newly formed Shock and Vibration Division, and to serve as its administrative and technical head in carrying out a program of research and testing. He held this position until the end of World War II.

He resigned from government service at the conclusion of World War II to enter private industry in the Boston area; accepted the position of vice-president and chief engineer of Barry Controls Incorporated, formerly The Barry Corporation, a concern engaged in the control of shock, vibration, and noise. This position he has held continuously to date, during which period the volume of business has increased 50 times. He holds a number of patents on railway-car structures and vibration-control devices. He has contributed articles to the journals of the engineering societies and to the technical press, and is the author of "Vibration and Shock Isolation" published by John Wiley and Sons, Inc., in 1951.

He has been a member of ASME since 1936 and has served the Society as chairman of the Boston Section, ASME. He is also a member of the Society for Experimental Stress Analysis, The Acoustical Society of America, The American Society for Engineering Education, Tau Beta Pi, Pi Tau Sigma, Theta Tau, and Phi Kappa Phi.

Arthur W. Weber

ARTHUR WILLIAM WEBER, who has been nominated from Region III to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, is vice-president and director of engineering and manufacturing staffs of Corning Glass Works, Corning, N. Y.

In 1933 he was graduated from Yale University with a Bachelor of Science degree, and began his career as laboratory engineering assistant with the National Sugar Refining Company in New York, N. Y.

From 1934 to 1935 he was technical trainee; first, with National Aniline and Chemical Company, Buffalo, N. Y., and later, with American Thread Company at Willimantic, Conn. In 1935 his career with Corning Glass Works commenced as mechanical engineer in the research laboratory in Corning, and during the past twenty-two years at various of the company's works he has progressed in the company both engineeringwise and in managerial phases until today he is not only vice-president, he is also director of engineering and manufacturing staffs.

As an Alfred P. Sloan Fellow, he studied at the Massachusetts Institute of Technology in 1940–1941 and in June, 1941, he received a Master of Science degree from the Institute. He is a registered professional engineer in the State of New York.

He has been a member of the Society since 1948 and holds membership in several other professional, educational, and honorary engineering societies. He is a vestryman serving in Christ Episcopal Church and a member of the Rotary International.

Ernst W. Allardt

Henry S. Aurand

Ernst W. Allardt

ERNST WILLIAM ALLARDT, who has been nominated from Region V to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, is chief engineer, Tubular Products Division of The Babcock and Wilcox Company, Alliance, Ohio.

A native of Ohio, he was born in Cleveland, Jan. 20, 1896, educated in the elementary and high-schools of the city, and from 1918 to 1921 he studied engineering at George Washington University. He also took several ICS courses in engineering.

He is considered a specialist in cold-roll metal-forming and electric weld tube and pipe mills. From 1922 to 1942 he was employed by The Yoder Company, Cleveland, Ohio, first as chief draftsman and later as chief engineer. During this period he was responsible for the design of several welded-tube mills 1 in. to 4 in. in capacity. He also designed a 26-in-diam pipe electric-resistance weld mill and accessory equipment at Youngstown Sheet and Tube Company. From 1936–1942 he designed many ERW tube mills and special sheet and strip metalworking machines.

In 1942 he joined The Babcock & Wilcox Company as chief engineer, Tubular Products Division, and has since designed several plants in the United States and Europe along with mills and accessory equipment.

Since joining the Society in 1926, Mr. Allardt has served ASME on the Executive Committee, Akron-Canton Section, 1946–1948, and as Section chairman 1948–1949; chairman of the Canton-Alliance-Massillon Section, which Section he helped to organize, 1950; and as chairman of the National Nominating Committee, 1954–1955; and many others. In 1951 he received the ASME Achievement Award. In 1955 he was awarded the ASME 75th Anniversary Medal; also in that year the ASME Certificate of Merit. Mr. Allardt has contributed extensively to the literature on operating electric-weld tube mills, including manuals, articles, and was the 1942 award winner of the James F. Lincoln Arc Welding Foundation. He holds several American and British patents.

Henry S. Aurand

HENRY S. AURAND, who has been nominated from Region VII to serve two years as Regional Vice-President of The American Society of Mechanical Engineers, received his BS degree from the United States Military Academy in 1915

At that time, he chose a mechanical rather than a civil-engineering career in the Army, by choosing the Coast Artillery Corps for his original commission rather than the Corps of Engineers. The next year, he was assigned to the Ordnance School at Sandy Hook Proving Ground.

His World War I service was at that station and included the design and layout of technical facilities for the then new Aberdeen Proving Ground, as well as a variety of proof officer assignments culminating with chief proof officer. After the war, he completed his Ordnance School courses. It was during this period that he first joined ASME and the American Ordnance Association.

Staff duty in the Corps Areas and on Corregidor, duty in the office of the Chief of Ordnance in Washington, and student and faculty assignments in the Army school system took much of his time between the wars. However, for two years he was Chief of the Technical Group at Picatinny Arsenal, New Jersey, which was responsible for the design of all types of ammunition used by the Army, except small arms. Many of the drawings which were used to manufacture ammunition at the start of World War II bore his signature.

1940 found him completing the course at the Army Industrial College. He was then assigned as chief of the Supply and Transportation Branch of the Supply Division of the War Department General Staff. War Department Research and Development was a section of his branch. His subsequent war assignments included: Defense Aid Director of the War Department, Secretary of the Combined Production Board, and Commanding General of the Sixth Service Command, the Normandy Base Section, the Service of Supply, China Theater, and the Africa-Middle East Theater, which he closed out.

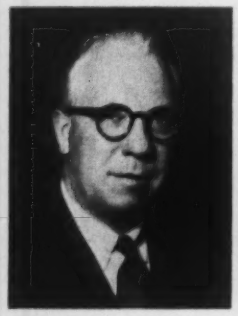
After World War II, he served in Washington as Director of Research and Development of the War Department and Director of Logistics of the Department of the Army. He was sent to Hawaii in April, 1949, to command the United States Army in the Pacific, and retired there in August, 1952, after more than 41 years' service. His service in the islands had convinced him that he should make his home there after retirement.

His retirement has been a busy one, mostly on a volunteer basis. His clubs are the University Club of New York, the Army and Navy Club of Washington, and the Pacific Club of Honolulu. He is a Rotarian and has been a director of the Honolulu Club. He is a member of the Engineering Association of Hawaii and director of the Pacific and Asian Affairs Council in charge of its High-School Program. He is the nominee for the presidency of the Hawaii Chapter, Association of the United States Army. Subsequent to his retirement he was given the honorary LLD degree by Olivet College, Michigan. He writes a weekly column for the *Honolulu Advertiser*, and two columns a week on foreign affairs for the *Maui News*.

General Aurand is a member of the Board of Advisers of the Institute of World Affairs and director of the United Services Life Insurance Company.

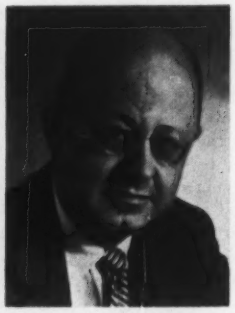
He has been most active in affairs of The American Society of Mechanical Engineers in Hawaii, having been the first chairman of the Hawaii Section, and having had much to do with the Region VII Administrative Conference held on Honolulu last year. Immediately after World War II he served as Army representative on the Society's Atomic Energy Committee.

Nominated for Director—Technical, Codes and Standards, and Administrative—to Serve Four-Year Term



Ronald B. Smith

Elmer O. Bergman



Louis N. Rowley, Jr.

Ronald B. Smith

RONALD BROMLEY SMITH, who has been nominated to serve as Director (Technology) of The American Society of Mechanical Engineers for a four-year term, is operating vice-president of M. W. Kellogg Company of New York. A member of the Advisory Board of New York University's Research Division, and a trustee of the New York Trade School, he is the author of a number of technical papers, notably in the fields of applied mechanics and gas-turbine design.

Born Oct. 28, 1907, in New London, Conn., Mr. Smith took his BS degree (cum laude) in 1930, at the University of Washington, following it three years later with an ME degree. In 1930 he was awarded the Western Washington ASME Student Prize. He did graduate work in electric engineering at the University of Pennsylvania from 1933–1935, and in physics and mathematics at the University of Michigan in 1936. The following year he received his MS degree from the University of Pittsburgh. He is a member of Tau Beta Pi and Sigma Xi.

Mr. Smith, a Registered Professional Engineer, began his engineering career with Westinghouse in 1930. He served at their East Pittsburgh and South Philadelphia plants until 1937, when he became design engineer with the Elliott Company, in Jeannette, Pa., later becoming assistant chief engineer, and then director of research for Elliott, and finally from 1945–1948, vice-president for engineering and research. At Elliott he pioneered in the development of turbosupercharging, the design of gas-turbine power plants, and the development of low-pressure air fractionation.

In 1945 he was a member of a U. S. Naval Technical Mission in the European theater. In the same year, Mr. Smith was winner (jointly with Dean C. R. Soderberg, Fellow ASME, of M.I.T.) of the Linnard Prize awarded by the Society of Naval Architects and Marine Engineers. From 1945 to 1948 he served as consultant to the Packard Motor Car Company, and on the Power Plant Committee of the National Advisory Committee for Aeronautics. He joined the Kellogg Company in 1948 and in recent years has been closely associated technically with the synthesis of gasoline from coal, particularly in South Africa.

In 1953 he received the Centennial

Citation awarded to a distinguished alumnus from the University of Michigan.

Since becoming a member, in 1930, Mr. Smith has served the ASME on a long list of committees, among them the Standing Committee on Power Test Codes; the Publications Committee, chairman, 1950; the Board on Technology, chairman, 1955; and the Finance Committee. He is chairman of *Applied Mechanics Reviews* Managing Committee and in 1945 he sponsored the Westmoreland Subcommittee of the ASME Pittsburgh Section.

The Society's new Director (Technology) is a member of The Engineers' Club, New York; the Riverside Yacht Club, Riverside, Conn.; and the Maccauvlei Country Club, Vereeniging, Orange Free State, South Africa.

Elmer O. Bergman

ELMER O. BERGMAN, who has been renominated to serve as Director (Codes and Standards) of The American Society of Mechanical Engineers for a two-year term, is staff-consultant with C. F. Braun & Company, Alhambra, Calif. His principal field of work is stress analysis on structures, pressure vessels, piping, and rigging. A native of Nebraska, he was born in Kimball, in 1892. He has received degrees from three educational institutions, which include: BA, Creighton University, 1920; BS, 1925, MS, 1926, and CE, 1932, University of Colorado; and PhD, Stanford University, 1938. From 1924 to 1937 he taught civil engineering and mechanics at the University of Colorado, and during this same period he did summer engineering work for the American Bridge Company, Wyoming State Highway Department, and two United States Bureaus, Standards and Reclamation, in Washington, D. C. He joined the Braun organization in 1938, following a year of study under Stephen P. Timoshenko, Hon. Mem. ASME. Mr. Bergman became a member of ASME in 1943. He serves the Society as a member of the ASME Boiler and Pressure Vessel Committee and of several of its subcommittees. He is chairman of the Subcommittee on Unfired Pressure Vessels. He belongs to a number of other technical societies, including The Institution of Mechanical Engineers (London). He was an American delegate to the 1953 Paris, France, meeting of the International Standards Organization, TC 11 on Boilers. He is the author of "Manual on Theory of Elasticity" and "Calculation of Stress Data From Strain Measurement," and joint author of "Materials Testing."

Louis N. Rowley, Jr.

LOUIS N. ROWLEY, JR., who has been nominated to serve as Director (Administrative) of The American Society of Mechanical Engineers for a four-year term is editor and associate publisher of *Power*, a publication of McGraw-Hill Publishing Company.

Born in Brooklyn, N. Y., Sept. 15, 1909, he was graduated from Brooklyn Technical High School in 1927; and in 1931 was graduated from Polytechnic Institute of Brooklyn with an ME degree. From 1931 to 1935, he was enrolled in the New York University Graduate School of Business Administration (Evening School) and was granted an MBA degree by the University.

While his early career, 1931 to 1937, was with Brooklyn Edison Company, doing various engineering jobs in the mechanical-engineering and construction departments, and construction cost control and scheduling for the last year of this period with Consolidated Edison Company of New York; the technical publishing field was soon to claim his services. In 1937 he was made assistant editor of *Power* and to this day, progressing to his present job, he has contributed in a major way to the high repute of his own publication and often led the way for others. Specifically, an entire generation of power engineers have been educated through the special reports, condensed treatises on current practice, he has been largely responsible for developing.

In addition to the influence which he exerted by his magazine, Mr. Rowley has been a frequent speaker and lecturer on subjects of concern to the power field. He is recognized as an authority on power in general and specifically in the fields of internal-combustion engines and gas turbines.

Since joining the Society in 1931, his professional society activities have been continuous and extensive. For example, he served as secretary and chairman of ASME Oil and Gas Power Division; member and chairman of ASME Publication Committee, Gas Turbine Power Division, Board on Technology, Finance Committee, and Joint Committee, ASME and American Rocket Society. He is presently a member of the Organization Committee and was until 1956 on the Special Committee on Affiliations.

With B. G. A. Skrotzki, Mem. ASME, and associate editor of *Power*, Mr. Rowley has been coauthor of several important technical papers published in the Transactions of ASME, and he is the author of many articles and special reports in *Power* which covered such varied subjects as heating, diesel and gas engine maintenance, diesel injection, and many others.

People

Honors and Awards. JEROME C. HUNSAKER, Hon. Mem. ASME, and professor of aeronautical engineering, The Massachusetts Institute of Technology, was given the gold medal of the Royal Aeronautical Society for outstanding work in aeronautics. The society made the award for "his contribution to aeronautical research and education, including his inspired chairmanship of the National Advisory Committee for Aeronautics, whose work has so greatly benefited aeronautical activities everywhere."

RAY EMIL BOLZ, Mem. ASME, and professor of aeronautical engineering, Case Institute of Technology, received the Yale Engineering Associated Award for Advancement of Basic and Applied Science. The presentation of the award was made at the annual meeting and dinner of the Yale Engineering Association held at the Yale Club, New York, N. Y., on May 9.

CLEMENT J. FREUND, Fellow ASME, dean of the College of Engineering, University of Detroit, was honored at a testimonial dinner given in recognition of his 25 years as dean. He received a framed testimonial and a 35-mm camera.

ROY H. HEALD, Mem. ASME, and an aerodynamics expert at the National Bureau of Standards, U. S. Department of Commerce, Washington, D. C., has been awarded the Department of Commerce Silver Medal for Meritorious Service. The award recognizes his "long and distinguished service in the field of missile aerodynamics."

GWILYM A. PRICE, Affiliate ASME, and president of the Westinghouse Electric Corporation, was awarded the honorary LLD degree at the 107th commencement exercises at Bucknell University, Lewisburg, Pa.

THOMAS H. WICKENDEN, Mem. ASME, and retired vice-president, International Nickel Company, Inc., was awarded the honorary DS degree at the 116th commencement exercises of Denison University, Granville, Ohio.

UET Reveals Site . . .

New Engineering Center in New York City

PURCHASE by the United Engineering Trustees, Inc., 29 West 39th Street, of 37,500 sq ft of property on the west side of First Avenue between E. 47th and E. 48th Streets at a price of "approximately $2,700,000" was announced June 29 by W. J. Barrett, president of the Trustees.

The site includes the entire block front on the west side of First Avenue between 47th and 48th Streets and extends back from First Avenue for 150 feet on E. 47th Street, and for 225 feet on E. 48th Street. This section of First Avenue has been renamed the United Nations Plaza.

Title to the principal part of the property was taken by UET June 29. Included is the portion owned by the Carey Garage Corporation containing a garage with entrance on E. 48th Street, and a vacant lot at the corner of First Avenue and E. 47th Street of which Peter W. Kuhn is the owner.

Previously acquired from the 849 First Avenue Corporation was a parking lot facing the United Nations Plaza, and a five-story tenement building at 344 E. 48th Street owned by Wallace Carter of New York City.

All negotiations were made through Cross and Brown Company, 270 Madison Avenue, New York City.

UET was established in 1904 and is the corporation in which five national engineering societies will now be associated in the development of the new property.

These societies are: the American Society of Civil Engineers; American Institute of Mining, Metallurgical and Petroleum Engineers; The American Society of Mechanical Engineers; American Institute of Electrical Engineers; and the American Institute of Chemical Engineers. More than 175,000 engineers in all parts of the world are members of the five groups.

For 51 years UET has owned and occupied its 16-story Center on West 39th Street. The structure was built in 1906 by a gift of $1,000,000 from the late Andrew Carnegie "to promote the solidarity of the engineering profession."

Mr. Barrett said that the basic purpose of UET is to advance the engineering arts and sciences in all their branches. He added that the purchase of the new site is "the first step in plans which the Trustees are formulating to meet a need for the expansion of the Center's activities."

In addition to Mr. Barrett, officers of UET are: Willis F. Thompson, Fellow ASME, of New Haven, Conn., and Andrew Fletcher of New York City, vice-presidents; Joseph L. Kopf, Fellow ASME, of New York City, treasurer; and S. W. Marras of New York City, secretary.

Twenty-First ASME National Applied Mechanics Conference Held June 13–15, University of California at Berkeley

WITH more than 180 in attendance, the twenty-first national Applied Mechanics Division Conference provided another proof for the drawing power of a meeting in California to members of The American Society of Mechanical Engineers. This Conference was the first held on the West Coast. A record number of papers, 45 in all, were presented by authors coming from all parts of the country.

The Conference was opened with a welcoming address by Morrough P. O'Brien, dean of the College of Engineering of the University of California at Berkeley, and by words of greeting from ASME President William F. Ryan. Both men dwelt on the growing use in mechanical engineering of advanced techniques taken from research in applied mechanics, physics, mechanics, and other scientific disciplines. Dean O'Brien emphasized the basic mission of the engineer to develop "hardware which works and which can be sold at a profit."

Mr. Ryan complimented the Applied Mechanics Division on its record of providing a sound basis for applied mechanics and urged members of the Division to mingle more with their colleagues in the other ASME divisions and to encourage the younger men concerned with applied mechanics in the local sections.

Technical Sessions

The subsequent 11 sessions of the Conference provided numerous examples for the interest of the Applied Mechanics Division in engineering problems and for the inspiration which these engineering problems provide for fundamental work of lasting value to the applied mechanics field.

To illustrate: Much attention was given to the basic mechanics of the porous and granular materials which overlie much of the surface of the earth, and provide the most common materials of construction, and retain within them liquids such as water and petroleum, vital for man's survival. Extensions of elastic theory were reported on, to cope with difficult nonlinear engineering problems in the stability of the plate elements widely used in structures to transmit loads in various combinations. Theories were presented to treat dynamic problems such as the transverse vibration in wires which support rocket motors under test, and the decelerating force applied to an airplane landing on a carrier deck as its landing hook engages with the cable of the arresting gear. This last problem was illustrated by photographs of actual landings which supported the theoretical analysis.

Laboratory Facilities Inspected

One afternoon was devoted to trips to the University of California Radiation Laboratory and to the Rarefied Gas Dynamics Laboratory. An evening was given to the banquet, at which more than 100 guests heard Joseph Kaplan, chairman of the U. S. National Committee for the International Geophysical Year 1957–1958 (IGY) trace the history of such international efforts, starting with the Polar Year of 1882–1883, of making simultaneous observations of geophysical phenomena over the surface of the earth in order to obtain a better understanding of these phenomena. He showed how IGY dwarfs all previous efforts, how it has caught the public imagination with its plans to launch earth satelites and how it is receiving co-operation from counties on both sides of the Iron Curtain thereby increasing the hopes for world peace.

The conferees will recall not only this banquet, but the many other acts of hospitality provided by the Conference Committee under the chairmanship of Prof. W. W. Soroka of the University of California.

Junior Forum

Conducted for the National Junior Committee

By H. N. Weinberg,[1] Assoc. Mem. ASME

What Can a Young Engineer Do to Develop Professionally?

The National Junior Committee has been sponsoring a series of panel discussions on the professional development of the young engineer. At the Spring Meeting in Birmingham, Ala., the theme was "What Can a Young Engineer Do to Develop Professionally?" Young mechanical engineers in San Francisco attending the Semi-Annual Meeting sought to determine "how" this is accomplished. The theme was divided into four parts: professional experience, professional knowledge, professional associations, and professional judgment.

The panelists who discussed this theme are eminent San Francisco-Bay Area engineers who are, in themselves, significant examples of professional engineers. The panel, with the chosen theme of each member, consisted of:

F. W. Beichley, engineering manager, Pacific Coast Region, Westinghouse Electric Corporation, San Francisco, Calif., speaking on professional experience;

S. De France, director, Ames Aeronautical Laboratory National Advisory Committee for Aeronautics, Moffet Field, Calif., speaking on professional knowledge;

R. E. Newton, professor and head of mechanical engineering, U. S. Naval Postgraduate School, Monterey, Calif., speaking on professional associations; and

A. K. Oppenheim, associate professor of mechanical engineering, University of California, Berkeley, Calif., and president of the Northern California Section of the American Rocket Society, speaking on professional judgment.

Chairman of the session was R. S. Steidel, Jr., of the University of California. The vice-chairman of the session was Ian Finnie, of Shell Development Company.

The following are digests of the remarks by Mr. Beichley, Dr. Newton, and Dr. Oppenheim. It is hoped that Dr. De France's remarks will be available for publication in a subsequent issue of Junior Forum.

[1] Process engineer, Esso Research and Engineering Company, Linden, N. J.

Professional Experience

By F. W. Beichley

How does professional experience affect professional growth of an engineer?

To answer this would seem easy, what with 20 years of personal industrial experience from which to draw. Then I began asking myself some questions. What have those 20 years really meant to my professional growth? Have I fitted that experience into a logical plan to grow? Have I failed to file my experience where it can readily be called up and used—or, perhaps failed to record it at all? Have I intelligently analyzed missing links in my chain of experiences necessary to becoming a well-rounded, genuinely professional man and successfully sought that experience?

Such questions bring a realization that the mere passage of time on the job constitutes one form of experience—but a useless, fleeting experience unless it is absorbed, evaluated, and used. We must open our eyes and ears and minds to it, or it can be as lost as are the beauties of a cross-country trip to the traveler who plays bridge all the way.

Webster defines experience as "The actual living through an event or events; actual enjoyment or suffering; hence, the effect upon the judgment or feelings produced by personal and direct impressions; as, to know by experience."

The importance of a planned program for gaining experience is seen in these few words—"the effect upon judgment produced by personal and direct impressions." If we observe carefully and accurately; analyze all the results of our daily experiences, both good and bad, mentally or otherwise catalog them for ready recollection; and manage to expose ourselves to a maximum number and a sensible mix of worth-while experiences, the effect upon our judgment is clear. It will increasingly possess the breadth of vision and soundness of decision that mark a professional engineer.

In our zeal to accumulate technical experience, we must not overlook what I have termed "a sensible mix" of experience. True, for some of us, our fundamental professional growth may be technical, but even the most technical man lacks the true depth of a professional engineer unless he is experienced in dealing with people, communicating ideas, and leading his fellow-workers in co-operative accomplishments. So, no matter how technically inclined you are, don't fail to include in your storehouse of experiences a liberal amount of observations useful in motivating people.

Then there are others of us who need to recognize that our professional growth leads eventually to management. This absolutely demands a mix of experience that includes all the do's and dont's about the conduct of business, economics, and handling people. When I began transportation-apparatus design work in 1940, I could not foresee the shift to administration that has now taken place. How easy to have ignored valuable observations on running an engineering organization had I not been prompted to be on the look-out for such things.

Maybe you already know that you are likely to trend to management—maybe not—but don't pass up any opportunities to get such experience. ECPD's little booklet, "Engineering—A Creative Profession," tells us that: "About 34 per cent of all engineers rise to positions with high executive responsibilities. Of all industrial executives about 40 per cent are engineers."

So, if you sometime feel the pinch of management on a pet project, consider it an opportunity to study management's viewpoint as well as your own. What will you do a few years hence in a similar situation? A realistic look at it may enable you to understand better management's stand on your immediate problem and store some experience for future use. If an honest, unbiased study of your reaction to the way things are done around you or perhaps the way you are managed convinces you that there must be a better way to get the same or better results, that too becomes valuable experience for the day you are in a position to show what you can do.

Don't neglect the so-called outside activities. Force yourself, if necessary, to do some public speaking, write some articles, or disclose some patentable ideas. These all help develop a proficiency in communications and creative thinking that marks an accomplished engineer.

ASME has been a priceless experience for me. Every committee appointment

Attention, Young Associates

Appointments of Junior Advisors to the various national committees of ASME will be made early in September. Advisers to the following committees have not yet been selected: Constitution and Bylaws; Professional Divisions; Education; National Membership Development; and Meetings.

Prime qualifications are that you: Be an Associate Member under 30; be able to do a nominal amount of traveling to meetings (generally held six to eight times a year in New York City) at your own personal or company expense; and most important, that you be vitally concerned with your own professional development and the Society's continued growth and progress.

If you are interested in this opportunity to participate intimately in ASME activities, call or write before August 20 to: Warren Thompson, chairman, National Junior Committee, United Engineers and Constructors, 1401 Arch Street, Philadelphia 5, Pa.

If you are interested in the activities of the National Junior Committee but are not readily available for active participation, you can become a corresponding member of the NJC, by writing a brief note about yourself indicating your main Society interests and sending it along to: William M. Morley, secretary, National Junior Committee, Elliot Company, 226 South 16th Street, Philadelphia, Pa.

has carried valuable lessons with it. Each has provided contact with top engineers and executives who are truly professional people. With only a little help on our part, a wealth of experience rubs off in such associations.

Your ability to interpret experiences and transpose them from specific instances to a broad variety of situations is important. For example, a big lumber mill is being engineered. The young engineer enthusiastically designs a log haul and log-carriage drive that can handle the biggest log in all the woods. Technically, his solution is impressive, but how many logs are that big? They may be so few in number that equipment to handle the largest log is completely and economically unreasonable. Better by far to handle anything that large as a special case and build the mill to handle the much more moderate size logs that comprise 99 per cent of the mill load—at a tremendous saving in equipment and operating cost.

An experience like this is worth its time in gold if this important point of good judgment illustrated is ear-marked as a check-point in every future load analysis, whether it be another mill, the size of airplanes for a given route, or the personnel to man an engineering department.

Experience can be dangerous too—unless it is applied with a liberal degree of common sense and recalibration with changing times. No engineer will grow professionally, who says: "Oh, that can't be done. We tried it in 1957 and it didn't work."

Experience, then, is indeed a major requirement for professional growth. Without it, we cannot become professional engineers. Don't leave gaining experience to chance but establish a plan for getting it that touches all bases. Yet, don't make that plan so hard and fast that you overlook unscheduled experiences that may suddenly pass your way.

Professional Associations

By R. E. Newton

My thoughts on the pursuit of rewarding professional associations seem to me like a statement of the obvious. However, I must observe that these things were not equally obvious to me 20 years ago. For this reason I offer them here.

Let us make clear at the outset that our concern is with the contacts between the young engineer and other engineers—not necessarily in the same specialty. Such activity is important to the engineer in two ways. One is that personal advancement depends upon being known by others in the profession and upon benefitting from their knowledge and experience. The other is that the recognition of engineering as a profession requires the continual efforts of each of us, acting both individually and in concert.

As we turn our attention to how we should accomplish this we recognize that a complete answer is impossible. For the young engineer who works for a company employing many other engineers, a source of professional associations is immediately at hand. It would be presumptuous to enter here upon a discussion of these relations, especially in view of the masterly treatment given by W. J. King.[2] However, it is unlikely that any engineer can find the desirable breadth and diversity of professional associations entirely within his company.

A far more comprehensive source is open to every engineer through his own engineering society. For many of us this is ASME, but it could equally well be any or several of the many engineering societies. Frequently, such an affiliation begins in undergraduate days. I began in this way and it has been a source of great satisfaction to me to recommend many of my students for junior membership.

Probably, the first way in which the young engineer gains a broader perspective concerning his profession, is through the publications of his society. Unless he is far from a metropolitan area, section meetings afford him an opportunity to meet and learn to know other engineers. On the technical side, he will probably find that a professional division of his section provides stimulating and challenging presentations of new developments. Again speaking personally, I can say that a 250-mile round trip each month for over four years to attend such meetings has been quite rewarding.

Regional and national meetings provide additional opportunities to further professional associations. At the risk of preaching heresy, I would emphasize that a major benefit to be derived is through the informal acquaintanceship with other engineers. The "bull session" may well compete with the technical session in long-run gains.

In many respects, the highest level of contribution to one's own professional stature and to the advancement of the profession, is through the preparation and presentation of papers. This is a place where the young engineer is well-advised to begin early. A kindred activity is the offering of timely discussion, both written and oral.

A genuine and continued interest in the affairs of an organization usually leads to more formal participation. The officers of the society at every level are largely drawn from those who willingly volunteered for the little jobs at the local level.

Much more could be said about the cultivation of strictly professional associations. Such elaboration would surely be superfluous for the man who has earnestly followed some of the paths already suggested. One final suggestion is, perhaps, in order. Engineers are particularly qualified to serve the com-

[2] "The Unwritten Laws of Engineering" by W. J. King, MECHANICAL ENGINEERING, vol. 66, May, June, July, 1944.

munity on such bodies as planning commissions, school boards, and many others. If we are to achieve truly professional status, we must be willing to serve.

Professional Thinking

By A. K. Oppenheim

The theme of our discussion is "how . . . ." This is quite appropriate since success in engineering depends in a large measure on "know-how." So far, we were concerned with the "know-how-to-acquire-experience," "know-how-to-acquire-knowledge," "know-how-to-acquire-friends," and now I am to add to it "know-how-to-acquire-a-thinking cap." I wish to point out a few things which, I presume, may be novel because of their unconventionality.

It is my belief that the faculty of thinking is an artificial evolution in the animal kingdom which eventually produced the Homo sapiens. So that in this sense, thinking might be even considered unnatural. Consequently, we have to, actually, force ourselves to think, or in other words, be driven to thinking. One of the most powerful sources of such a drive to think is fortunately provided by the natural instinct of curiosity and inquisitiveness—the strife for an answer to the question why. So, as contrasted to the know-how, the result of thinking is the "know-why."

There are various types of thinking involved in carrying out our professional tasks: First is the one which can see and follow the intricate technical details of the problem, organize them, and carry to solution. This type follows most closely the principles of logic and is in character the same as required for the solution of mathematical problems and may be referred to as mathematical thinking.

Then there is the creative thinking, the thinking most closely associated with imagination and inspiration, the talent for sculpturing new avenues of progress, the pioneering "gift of God" part of the art of engineering. This type of thinking cannot be taught directly nor really even developed by exercise. It can only be stimulated by either the "will to conquer," nourished by the drive to attain some worthwhile objective, or by healthy competition and argument. Above all, however, it should be recognized as one involving "the religious concept of guidance by God's infinite wisdom."

Finally, there is the ability for over-all thinking; the one most useful for executive decisions. And here for engineers is perhaps the surprising but at the same time comforting fact; that over-all thinking requires only that they utilize principles and methods that they learned in the study of thermodynamics. This is the method of attack which results in the correct analysis of an over-all situation without requiring complete entanglement in all of the minute details.

ASME Codes and Standards Workshop

Head of Codes and Standards Service Appointed

J. D. Wilding has been named head of the Codes and Standards Service of the Society, which includes the Boiler and Pressure Vessel Committee, Power Test Codes Committee, Standardization Committee, and the codifying activities under the Safety Division.

Mr. Wilding has been Secretary of the Boiler and Pressure Vessel Committee since 1954. See "ASME News" page 810 for details.

Mechanical Vibration and Shock

The Society has accepted co-sponsorship of a new sectional committee, Sectional Committee S2 on Mechanical Vibration and Shock. The administrative sponsor is the Acoustical Society of America. The relationship is to be reviewed within a year.

Chairman of the Committee is Horace M. Trent; vice-chairman is Charles E. Crede, Mem. ASME.

The new committee S2 is one of three (S1, S2, and S3) to be formed from the previous Sectional Committee Z24 on Acoustics, Vibration, and Mechanical Shock. The three committees will cover acoustics, vibration, and mechanical shock in relation to such subjects as hearing and speech, shock testing, calibration of instruments, microphones, and balancing of machinery.

Standardization of Automatic Controls Terminology

—A Report by the Officers of Sectional Committee C85

The increased use of automatic controls in manufacturing industries, in process industries, and in business administration has brought about a need for creating a common language for this field of engineering effort. Under the auspices of the American Standards Association, a project has been started to establish standard terms pertaining to automatic control and to develop definitions of such terms.

To handle this project, Sectional Committee C85 has been constituted under ASA procedure. Its organization was approved by ASA as of April 5, 1955. Its title is "Terminology for Automatic Controls." Its sponsor is The American Society of Mechanical Engineers. Its scope is as follows: "Terminology pertaining to systems such as: automatic process control, feedback control, regulating and other related systems not requiring human intervention as part of the regulating procedure."

Committee officers are: *Chairman*, M. A. Princi, General Electric Co., Lynn, Mass.; and *Secretary*, G. W. Heumann, General Electric Co., Schenectady, N. Y.

C85 is charged with the responsibility of establishing standard terms and defining them. Therefore, the document which C85 is developing will be a dictionary of terms and definitions. In this work, a close relationship is being maintained with Sectional Committee Y10, also under the auspices of ASA, which has been assigned the responsibility for letter symbols used in automatic control systems.

A review of source material published in the United States brought to light over 100 items of published standards, drafts of standards, papers, and articles dealing with terminology for automatic control systems. In the foreign field, standards on automatic control terminology have been issued by Great Britain, the Netherlands, and Western Germany. A Technical Committee of the International Electrotechnical Commission is working on a glossary of automatic control terms, but no published document is available as yet.

As an initial step in organizing its work, C85 has set up several subcommittees, each being assigned a certain work area which will be covered in the initial document which C85 plans to publish. The subcommittees and their work areas are:

Subcommittee 1 "Types and Components"—Chairman H. A. Miller, Raytheon Manufacturing Company, Waltham, Mass. The committee is working on definitions to describe the basic types of automatic control systems and the various component elements of each system.

Subcommittee 2 "Signals"—Chairman D. H. Smith, Bell Telephone Laboratories, New York, N. Y. This committee is defining the signals and process variables which are present in a generalized feedback control system.

Subcommittee 3 "Modes and Parameters"—Chairman W. I. Caldwell, Taylor Instrument Co., Rochester, N. Y. This committee is working on terms describing automatic control action, and the fixed or adjustable parameters which influence control action.

Subcommittee 4 "Behavior and Presentation"—Chairman H. L. Mason, National Bureau of Standards, Washington, D. C. This committee defines terms describing in detail the responses of automatic control systems, and their generalized controlled elements.

A Co-ordinating Committee under the chairmanship of O. W. Livingston, General Electric Co., Waynesboro, Va., has been established to resolve questions of concept, procedure, and style as they affect all subcommittees. It will also serve as an editorial committee to draft the tentative Standard which will contain the definitions developed by the above listed subcommittees.

A number of meetings of the main Committee and of the subcommittees have been held, and some 200 terms have been defined tentatively. It is anticipated that these definitions will be distributed for comments in the near future.

The initial phase of the work of C85 will probably be consummated during the current year. It is expected that C85 will then proceed to cover additional work areas and go more deeply into the fields of specific control systems.

Actions of the ASME Council

At Semi-Annual Meeting, June 8 and 10, 1957, Sheraton-Palace Hotel, San Francisco, Calif.

THE Council of The American Society of Mechanical Engineers met in three sessions during the Semi-Annual Meeting, Sheraton-Palace Hotel, San Francisco, Calif., June 8 and 10, 1957. There were present: W. F. Ryan, president; W. H. Byrne, C. E. Crede, B. T. McMinn, A. C. Pasini, J. H. Sams, C. H. Shumaker, and R. S. Stover, vice-presidents; E. O. Bergman, F. L. Bradley, G. A. Hawkins, E. W. Jacobson, R. B. Lea, Joseph Pope, V. Weaver Smith, and G. B. Warren, directors; F. S. Blackall, jr., J. Calvin Brown, and W. H. McBryde, past-presidents; E. J. Kates, assistant treasurer; C. E. Davies, secretary; Ralph Goetzenberger and V. A. Peterson, former members of the Council; J. S. Morehouse, Board on Honors; L. F. Deming, Washington, D. C., Section; G. Iglehart, Semi-Annual Meeting Committee; Ian Finnie, Junior Observer; Harold Grasse, Secretary, Region VIII, J. de S. Coutinho, Metropolitan Section, and H. Sternau, guests; R. B. Parker, H. J. McCabe, J. R. Muenger, A. M. Perrin, W. E. Belcher, Jr., L. D. Conta, E. M. Williams, F. R. O'Brien, G. R. Lord, J. D. Carr, D. B. Chenoweth, H. A. Jesperson, R. M. Kuhns, A. H. Jensen, Regional Delegates; O. B. Schier, 2nd, deputy secretary; T. A. Marshall, Jr., S. A. Tucker, and W. E. Reaser, assistant secretaries; J. J. Jaklitsch, Jr., Editor; and Ernest Hartford, consultant.

The following actions are of general interest:

Announcements. A letter of thanks from Miss Frances Selig for the gift by present and former members of the Council in recognition of her fifty years of service to the Society, was read by the Secretary.

A letter from S. M. Marshall, a Fifty-Year Member, who was unable to be present to receive his button was read.

It was reported that Henry Marx would be 99 years old on June 22, 1957, and the Secretary was asked to convey the best wishes of the Council to him.

It was reported that W. F. Durand, past-president and Honorary Member, had suffered two strokes and that he was receiving flowers at intervals from his ASME friends; and that Henry H. Snelling had suffered a heart attack and was under a doctor's care.

The deaths, on May 30, 1957, and June 6, 1957, respectively, of Joseph B. Armitage, past-director ASME, and Harry S. Rogers, President of the Polytechnic Institute of Brooklyn and past-president, ECPD, were noted.

ASME Budget, 1957–1958. Policies and budget for 1957–1958 were approved.

Status of Tax Case. The Secretary reported that in 1956 the Internal Revenue Service had questioned the liability of ASME to pay federal income tax on income from advertising in Society publications. The question involved is whether such income is derived from an "unrelated business" within the meaning of the Internal Revenue Code. The matter is currently under consideration by Exempt Organizations Branch of the Commissioner's Office in Washington. ASME attorneys have asked for a hearing and have been advised that final decision may not be reached for some time.

Constitution and By-Laws. The Council noted to adopt ammendments to Art. B7, Pars. 4, 17, and 18, which were offered for first reading Nov. 24, 1956, and received for first reading a proposed ammendment to Art. B8, Par. 7.

Board on Honors. On recommendation of the Board on Honors the following awards for 1957 were approved: ASME George Westinghouse Medal to Alfred Iddles, Fellow ASME.

Holley Medal to Charles Stark Draper, Fellow ASME.

Worcester Reed Warner Medal to William Prager, Mem. ASME.

Prime Movers Committee Award to H. Hegetschweiler and Robert Lawrence Bartlett, Mem. ASME, for their paper "Predicting Performance of Large Steam Turbine-Generator Units for Central Stations."

Stephen Timoshenko Medal. The Council approved the revised deed of gift to establish the Timoshenko Medal and voted to award the first medal to Stephen Timoshenko at the 1957 Annual Meeting.

American Rocket Society. On recommendation of the Board on Technology, the Council modified its previous action and voted that for a trial period of one year the American Rocket Society be represented by a member of its governing body on the ASME Board on Technology, without vote with the privilege of sitting, without vote, with the ASME Council, except in executive section; and that the ASME Council be represented by a member on the Executive Com-

mittee of the American Rocket Society, without vote, with the privilege of meeting, without vote, with the Board of the American Rocket Society, except in executive session.

Lectureships Committee. The Council noted that on recommendation of the Meetings Committee to the Board on Technology, the Lectureships Committee will remain a special committee reporting to the Board.

Policy on Meeting Location. On recommendation of the Meetings Committee and the Board on Technology a revised statement of the Policy on Meetings Locations and Dates was approved. The Council also upon recommendation of the Board approved a Policy and Procedure Governing Exhibits and Expositions.

Division Conferences and Congress, for 1957–1958 were reported as follows: Sept. 9–13, 1957—Instruments and Regulators Division in co-operation with 12th Annual Instrument Society of America Conference and Exhibit, Cleveland, Ohio.

April 1–3, 1958, Instruments and Regulators Division Conference University of Delaware, Wilmington, Del.

Sept. 4–5, 1958, Second International Congress on Air Pollution, New York, N. Y.

Railroad Division. A Custodian Fund for the Railroad Division was approved subject to acceptance by the Finance Committee.

Sections. Assignments of certain counties to the Louisville, Rock River Valley, St. Joseph Valley, and Minnesota Sections were authorized.

On recommendation of Bryan T. McMinn, Vice-President, Section VII, the establishment of the Idaho Falls Group of the Inland Empire Section, with headquarters at Idaho Falls, was authorized.

Student Sections. It was reported that up to June 6, 1957, a total of 10,320 undergraduates had been accepted as Student Members of the Society. Of the 1957 enrollment, 455 have been promoted to Associate Membership from 828 Student Members to be graduated prior to June 1, 1957.

Certificates of Award. Certificates of Award were granted to the following retiring chairmen of Sections: Inland Empire Section, Ralph Landerholm; Sacramento Subsection, Leonard D'Ooge. Certificates also were granted to the following members of the Nominating Committee: Ernest H. Hanhart, chairman; Raymond H. Stockard, secretary; Stephen L. Grapnel, Henry F. J. Skarbek, Thomas J. Judge, John F. Cunningham, Jr., George H. Frost, Walter A. Biddle, Robert W. Cox, Otto de Lorenzi, and Hendley N. Blackmon.

New Engineering Center. The Secretary reported that the site of the new United Engineering Center in New York City had been 90 per cent secured and the fund-raising campaign was about to begin. The UET Depreciation Fund of $1,300,000 is sufficient to purchase less than 50 per cent of the land and ASME has been asked to advance $500,000 to UET to be covered by UET promissory notes running to Jan. 1, 1959, paying interest at $4^1/_2$ per cent. The Council voted to loan the amount requested and authorized the Finance Committee and Treasurer to do so.

Engineering Institute of Canada. It was reported that a revised agreement between The Engineering Institute of Canada and ASME was signed May 6, 1957.

Appointments. The following Presidential Appointments were reported:

Annual National Conference and Convention, American Institute of Industrial Engineers, May 16, 1957, New York, N. Y., William H. Byrne.

Luncheon, New York State Society of Professional Engineers, May 18, 1957, New York, N. Y., William H. Byrne.

Centennial Celebration, Institute of Engineers and Shipbuilders of Scotland, June 25–27, 1957, Dr. Douglas G. Sopwith.

Annual Meeting, National Society and Professional Engineers, Dallas, Texas, Irving Comroe.

1958 Nuclear Congress. The 1957 Nuclear Congress was handled by the ASME. The 1958 Congress will be handled by the American Institute of Chemical Engineers. At a meeting of the Operating Committee the six participating societies underwriting the 1958 Congress decided that each society would advance funds to help handle the expenses to be incurred, these advances to remain in a fund to be transferred each year to the managing society. This arrangement was approved by the ASME Executive Committee on Feb. 2, 1957, and the Council voted to advance $5000 from the "A" Development Fund to underwrite expenses incurred in organizing and operating the 1958 Nuclear Congress.

Regional Delegates Conference. W. E. Belcher, Speaker of the 1957 Regional Delegates Conference, presented the recommendations of the Conference to the Council, which expressed appreciation of the work of the Delegates and referred the recommendations to the committees concerned for report to the Council.

Regional Realignment. The Deputy Secretary reported that a study of Regional boundaries is in progress. The Council requested the Vice-Presidents to include in this study, costs, changes in the Constitution and By-Laws, and Charter, and to report to the Organization Committee and the Council one month before the Annual Meeting.

ASME Emblem. Permission was granted to the New Orleans Section to reproduce the ASME emblem for suitable mounting and display in the Engineers Club of New Orleans.

Roosevelt Field Aviation Mural. A committee was appointed to study the feasibility of salvaging the Aviation Mural in Hangar F, Roosevelt Field, Long Island, N. Y., and, if practicable, to raise the necessary funds immediately.

Resolution of Thanks. The Council extended their thanks and sincere appreciation to the officers and members of the San Francisco Section for their "generous hospitality, gracious courtesies, and perfect weather."

Executive Session of the Council

THE Council met in executive session on the evening of June 8, 1957.

Honors. On recommendation of the Board on Honors, E. G. Bailey, past-president ASME, was elected Honorary Member and awarded the 1957 ASME Medal to Llewellyn M. K. Boelter, Fellow ASME.

ECPD. President Ryan distributed copies of the letter by M. S. Coover, president, American Institute of Electrical Engineers, referred to in the editorial of the July, 1957, issue of MECHANICAL ENGINEERING and reprinted on page 693 of the same issue. Mr. Ryan recommended support of the AIEE by parallel action by ASME. The subject will be taken up at the next meeting of the Council.

Staff Personnel. Appointments of John D. Wilding as assistant secretary (Codes and Standards) and William E. Reaser as assistant secretary (Field) were reported. Approval was voted of the designation of O. B. Schier, 2nd, as secretary-elect, to be appointed by the 1957–1958 Council, Dec. 2, 1955. C. E. Davies will relinquish the office of Secretary at that time.

ASME 1958 Nominating Committee Organizes

ELECTED at the 1957 Semi-Annual Business Meeting of The American Society of Mechanical Engineers, San Francisco, Calif., June 10, 1957, the 1958 National Nominating Committee at its organization meeting chose Arthur B. Heiberg as chairman, and Charles A. Davis as secretary.

The 1958 National Nominating Committee is composed of the following:

Region I. Representative, Roger M. Scott, assistant manager, Wire Machinery Division, Morgan Construction Company, 15 Belmont St., Worcester, Mass.; *1st Alternate*, John P. Heumann, mechanical engineer, research department, Olin Mathieson Chemical Corporation, 275 Winchester Ave., New Haven 4, Conn.; *2nd Alternate*, Rodger B. Dowdell, fluid mechanical engineer, Builders-Providence Inc. Div., B-I-F Industries, 345 Harris Ave., Providence, R. I.

Region II. Representative, James L. O'Neill, manager, Industrial Sales Division, Daystrom Electric Corporation, 753 Main St., Poughkeepsie, N. Y.; *1st Alternate*, U. A. Rothermel, lecturer, mechanical-engineering department, City College of New York, Convent Avenue at 139th St., New York 31, N. Y.; *2nd Alternate*, Walter B. Moen, assistant director of metallurgical research, Air Reduction Co., Inc., Murray Hill, N. J.

Region III. Representative, George R. Leavitt, development engineer, Taylor Instrument Companies, 95 Ames St., Rochester 1, N. Y.; *1st Alternate*, William G. McLean, head, department of mechanics, Lafayette College, Easton, Pa.; *2nd Alternate*, William E. Hammond, chief engineer, The Air Preheater Corporation, Andover Road, Wellsville, N. Y.

Region IV. Representative, Kenneth R. Daniel, vice-president and chief engineer, American Cast Iron Pipe Company, P. O. Box 2603, Birmingham, Ala.; *1st Alternate*, Harold K. Couch, partner, Brown & Morrison, 207 Liberty Life Building, Charlotte 2, N. C.; *2nd alternate*, Claude L. Huey, application technician, The Babcock & Wilcox Company, 1315 Candler Building, Atlanta 3, Ga.

Region V. Representative, Arthur B. Heiberg, development engineer, Firestone Tire and Rubber Company, 1200 Firestone Parkway, Akron 17, Ohio; *1st Alternate*, Winthrop I. Collins, district sales manager, The Babcock & Wilcox Company, 2730 Koppers Building, Pittsburgh, Pa.; *2nd Alternate*, William C. Beatty, plant engineer, E. W. Bliss Company, 1375 Raff Road, S.W., Canton 10, Ohio.

Region VI. Representative, Charles A. Davis, manager mech. test., Deere & Company, 1325 Third Ave., Moline, Ill.;

Engineering Societies Personnel Service, Inc. (Agency)

THESE items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York, 8 West 40th St. Chicago, 84 East Randolph St. Detroit, 100 Farnsworth Ave. San Francisco, 57 Post St.

Men Available[1]

Sales Engineer, Machinery, BS, 28; design and testing of heavy and medium-heavy machinery ten years; would like to apply knowledge of machinery to sales and/or representative field. Prefers New York City and Long Island. ME-407.

Mechanical Engineer, BSME and BSEE; 31; design of small, high-speed electromechanical and magnetic devices and test equipment for large, electronic, digital computers; design of nuclear instruments; artillery and rocket-trajectory calculations; total experience six and one half years. Prefers England. ME-408.

Manufacturing Engineer, Plant Manager or Assistant, BME, 34; 13 years' manufacturing and management metalworking, finishing, tooling, machinery, cost reduction and control, plant engineering, maintenance, labor. Prefers metropolitan New York. ME-409.

Plant Manager—Management Engineer, BS; 45; ten years' heavy experience in general plant management. 13 years' all phases of industrial engineering. Heavy in foundry industry. Management controls, labor relations, cost controls, etc. Prefers, easter nUnited States. ME-410.

Industrial Engineer, MBA, BME, 25, single, veteran; two years' broad manufacturing experience in methods, motion-time analysis, cost estimating, etc., with electrical assembly. Desires change of industry. Location open, United States or overseas. ME-411.

Plant or Project Engineer, BSME; 29; nine years' varied experience in plant layout, design, and installation of chemical-processing and material-handling equipment. Ability to estimate and maintain cost records for plant improvement and expansion projects. Prefers Pacific Coast. ME-412-216-San Francisco.

Industrial Engineer, BIE, 32; seven years' broad experience in the application and administration of incentive, cost, and production-control systems coupled with two years as an instructor of industrial-engineering subjects at university level. Prefers New York metropolitan area. ME-413.

Chief Power-Plant Engineer, 50; 25 years' experience with continually increasing responsibility in power-plant supervision. Steam, hydro, and diesel electric. Prefers New England or South. ME-414.

Mechanical Engineer, BSME, 42; nine years organization and management of quality control, eight years design, three years sales and service in farm machinery, ordnance, automotive and metal fabricating. ME-415-821-Chicago.

Engineering Sales, Capital Equipment, registered Pa, ASCE; 42. Experience design and construction special chemical-process equipment, hydraulic and mechanical presses. Abrasive and pharmaceutical fields. ME-416.

Superintendent, BS, Met. Engrg, registered; 40; mechanical-engineering marine and power plant as specialty; 16 years' experience including project design and production in ship construction and outfitting. Location open. Me-417.

Mechanical Engineer, 61, ten years construction, (in foreign service) mechanical; 13 years construction and maintenance; five years consulting engineer; seven years' industrial engineer. Experienced in construction of housing areas, hospitals, steam-generating plants, POL storage areas, armament shops, and industrial buildings. Location open; prefers foreign service. ME-418-340-San Francisco.

Product Design or Plant Engineer, BSME, 34, 15 years' diversified background in equipment design, plant engineering, product development, and manufacturing of semi-heavy industrial machinery. Seeks responsible position with medium sized company on supervisory level. Prefers metropolitan New York area. ME-419.

[1] All men listed hold some form of ASME membership.

Positions Available

Teaching Personnel. (*a*) Chairman, department of mechanical engineering, PhD desired, some administrative ability as well as teaching experience. Salary open. (*b*) Instructor or assistant professor in mechanical engineering, PhD or MS degree, to teach undergraduate mechanics and thermodynamics. Research experience desired. Salary and rank open depending upon experience. Available September, 1957. Pa. W-4383.

Teaching Personnel, Mechanics, Applied Electricity, General Physics. (*a*) Head of mechanics department, PhD in engineering preferred but will consider BS or MS. In addition to mechanics must be able to teach applied electricity (electrical machines and associated circuits). (*b*) Instructor to teach in the mechanics and physics department, MSME preferred but will consider a BS. Salary and rank dependent upon qualifications. Salary scale good. Room for advancement. West. W-4988.

Manager, Industrial Engineering, 30–45, degree in industrial or mechanical engineering, with eight to ten years' manufacturing or industrial-engineering experience in the metalworking industries, preferably with metal fabricating and assembly manufacturer. Specific experience in field of machining, plating, presswork, and assembly operations. Five years' experience as chief industrial engineer with responsibility for administration of industrial-engineering function of 500–2000 man operation. Salary open. Pa. W-5007.

Director of Engineering and Research, 35–45, mechanical-engineering graduate, with at least ten years' administrative, research, and product-engineering experience, covering food and chemical - process machinery, control, and materials-handling equipment. $12,000–$15,000, plus bonus. Midwest. W-5025.

Machine Designer, six to eight years of machine design, in field of metal-processing machinery. Machine experience considered likely background experience. Will study and evaluate methods of manufacturing with a view to actual development of new or improved types of production machines. Processes include blanking, roll forming, piercing, positioning, brazing, welding, soldering. $9000–$10,000. Upstate N. Y. W-5042.

Associate Professor of Engineering Administration, master's or PhD preferred. Should have a combination of industrial experience and some

1st Alternate, Robert D. Teece, manager, Central Engineering Division, Hernischfeger Corporation, 4400 W. National Ave., Milwaukee 15, Wis.; *2nd Alternate*, T. Randall Du Bois, works manager, Ramsey Corporation, 3696 Forest Park Boulevard, St. Louis 8, Mo.

Region VII. Representative, Leonard C. Koke, manager special products design, General Electric Company, Richland, Wash.; *1st Alternate*, Richard H. Meleney, Convair-Astronautics, Division of General Dynamics Corporation, San Diego 12, Calif.; *2nd Alternate*, Emmett E. Day, professor of mechanical engineering, mechanical-engineering department, University of Washington, Seattle 5, Wash.

Region VIII. Representative, Robert B. Kinzbach, vice-president, Kinzbach Tool Company, Inc., Post Office Box 277, Houston 1, Texas; *1st Alternate*, Allen H. Jensen, engineer, New Orleans Public Service, Inc., Market Street, New Orleans, La.; *2nd Alternate*, John W. McKiernan, division supervisor, Sandia Corporation, Sandia Base, Albuquerque, N. Mex.

Technical Division. Representative, Jess H. Davis, president, Stevens Institute of Technology, Hoxie House, Hoboken, N. J.; *1st Alternate*, Allen W. Thorson, manager, reactor operations, General Electric Company, West Milton Site, West Milton, N. Y.; *2nd Alternate*, Everett P. Partridge, director, Hall Laboratories, Inc., Division of Hagan Chemical & Controls, Inc., P. O. Box 1346, Pittsburgh 30, Pa.; *3rd Alternate*, Kerr Atkinson, consulting engineer, Statler Office Building, Boston 16, Mass.

Codes and Standards. Representative, A. William Meyer, director of patent and engineering investigations, Brown & Sharp Manufacturing Company, Providence 1, R. I.; *1st Alternate*, Rawleigh Mac Johnson, engineer, Charge of Tests, Compressor Division, Ingersoll-Rand Company, Phillipsburg, N. J.; *2nd Alternate*, to be appointed.

Administrative. Representative, Robert Nelsen, manager, technical publications, Aircraft Gas Turbine Division, General Electric Company, Cincinnati 15, Ohio; *1st Alternate*, Harold E. Martin, president, Metal & Thermit Corporation, 100 Park Ave., New York 17, N. Y.; *2nd Alternate*, G. B. Thom, chairman, mechanical-engineering department, Newark College of Engineering, 367 High St., Newark, N. J.

teaching experience. Opportunity for consulting research in this field. $6500–$8000. East Coast. W-5067.

Project Managers and Senior Project Engineer, graduate mechanical or chemical engineers, to assume responsibility for major projects in low-temperature or applied cryogenics. Should be able to finalize process and engineering flow sheets, prepare specifications for equipment piping and erection, supervise design, procurement, manufacture, and erection, test and final acceptance. To $12,000. Pa. W-5081.

Wage Administrator, 32–40, college graduate, experienced in job evaluation with organized employees. Will administrate wage program in a large progressive manufacturing organization. Supervise job analysts, conduct area-wage surveys, serve on appropriate corporation and community committees concerned with area of responsibilities. Potential for promotion to wage and salary administrator. $8000–$10,000. Upstate N. Y. W-5087.

Engineers. (*a*) Production engineer, graduate mechanical or industrial, production-control experience, to assist with design and production of nuclear fuel elements for a variety of reactors being constructed, mostly in the submarine field. A minimum of three years' experience in this field required; knowledge of machine tools is desired. (*b*) Methods and standards engineer, BS in chemistry, physics, mathematics, or engineering, with two to four years' industrial experience or equivalent; quality control or operations research desirable. (*c*) Quality control engineer, BS; prefer chemistry, physics, math, or engineering major with statistical training. Research or development experience is required. Will be responsible for control and selection of fuel-bearing component loading. Salaries open. New England. W-5093.

Manager of Industrial Engineering for a consulting engineering firm. Will direct six to eight engineers in job evaluation, standards, wage incentives, production control, plant layout, etc. Considerable travel. To $12,000, plus 30 per cent to 40 per cent bonus. Canada. F-5097.

Plumbing Engineer to design the various types of plumbing systems for buildings; should be a good draftsman. Should be experienced in designing various types of plumbing systems for hospitals, office buildings, schools, college buildings, churches, commercial buildings, etc. Systems include soil, waste, and vent piping; storm-water drainage; hot tempered, cold, and chilled water piping; sprinkler piping, etc. Salary open. Va. W-5100.

Design Engineer, mechanical or chemical-engineering graduate, at least five years' senior project engineering and design experience covering chemical-processing equipment in a rayon plant. $10,000–$12,000. Mexico. F-5106.

Assistant Project Engineer, graduate mechanical, minimum of two years' experience, preferably in engineering development work plus customer contact, plant liaison, project planning, and scheduling. Development testing or design experience in the field of plastics, rubbers, aeronautics, combustion, or metal fabrication valuable. Salary open. Md. W-5110.

Assistant Chief Mechanical Engineer, 35–40, mechanical graduate, at least five years' supervisory design and project-engineering experience covering high-pressure steam-power plants. To $14,000. Company pays placement fee. Eastern Pa. W-5114.

Teaching Personnel for a University. (*a*) Instructors, two, for full-time teaching on a nine-month basis. $4500–$5000 depending upon experience, and academic record. (*b*) Assistants, two, for half-time teaching on a nine-month basis. Salary, $1800 for nine months. Midwest. W-5116.

Sales Manager to head up a new division within the company's marketing structure; 35–45, graduate mechanical; previous experience should have been as general sales manager, district or divisional sales manager, assistant sales manager, or sales-engineering representative working for a manufacturer of medium-to-heavy auxiliary equipment sold, on a negotiated and engineered basis, to builders of cargo trailers, truck bodies, freight cars, unit cargo containers, etc., in either standard or special design. Salary in five figures, with eventual participation in profits; fringe benefits. Midwest. W-5118.

Manufacturing Executive, to about 40, graduate mechanical, experience at executive level in heavy metalworking plants; knowledge of metals, steels, and alloys. Must have keen ability in developing and improving methods and equipment; should have interest in and some contact with industrial sales and market development for technical products. $30,000–$35,000, plus bonus. East. W-5119.

Technical Writer, graduate mechanical, who is familiar with power plants, process plants, and commercial and institutional buildings from the standpoint of heat generation and transmission. Some experience in technical publicity or trade-paper work. Will act in a liaison capacity with engineering and research and manufacturing committees of a trade association. $8000. New York, N. Y. W-5123.

Assistant Purchasing Agent, ChE or ME, experience in purchasing towers, coolers, pressure vessels, and the like, for large chemical company. $8500–$10,000. New York, N. Y. W-5125.

Manager or Industrial Engineer, graduate mechanical or industrial, ten to 15 years' experience in chemical, pharmaceutical, or food-processing industry. Any experience in packaging desirable. $10,000–$12,000. Suburban N. Y. W-5127.

Manufacturing Manager, 50–60, mechanical or civil-engineering graduate, at least ten years' managerial experience covering engineering and production of heavy steel products associated with power-plant and water-works industry. $20,000–$25,000. Midwest. W-5128.

Production Manager, 35–45, who has had background in precision work, i.e., running a large precision machine shop. Work will involve supervision of 60 to 70 people which will eventually grow to 150 employees. $13,000–$17,000. Company pays placement fee. Conn. W-5130.

Engineers. (*a*) Senior industrial engineer, 25–37, preferably graduate, experience in methods, standards, layouts, cost reduction; prefer heavy industrial background such as aluminum or steel plant. Will study, investigate, and develop improvements in manufacturing operation to reduce operating cost and to increase production capacity and efficiency etc. Salary open. (*b*) Industrial engineer, 25–35, industrial-engineering experience pertaining to methods, standards, layouts, cost-reduction expense; two to five years' experience desired. Will prepare process charts, make timetable, and collect standard data on special assignments; analyze plant physical layouts, to evaluate effort on operating procedures and space requirements, etc. Salary open. South. W-5144.

Materials-Handling Engineer, mechanical or industrial-engineering graduate, with varied experience in materials handling and warehousing, to make surveys, analyze operations, prepare reports, specifications, and estimates covering equipment installations. $8000–$10,000. New York, N. Y. W-5149.

Engineers. (*a*) Plant supervisor, tank farm, to 40, two years college desired, minimum of eight years' practical field operating experience about mechanical equipment with emphasis on power-rpant operation. Will be responsible for operation of diesel-driven electrical plant. Will perform starting and placing generating equipment on line and proper operation of auxiliary equipment and switchgear. Operation of crude oil pipeline shipping, pumps and diesel drivers, plus auxiliary equipment and related tank farm. $10,500, plus monthly allowance in local currency. If married, family separation of approximately one year before housing will be available. (*b*) Plant supervisor, marine terminal, to 40, two years of college desired, minimum of eight years' practical operating field experience about mechanical equipment with emphasis on pumping problems related to tanker loading. Will be responsible for operation of diesel-driven pumps and auxiliary equipment, terminal crude tank farm, etc. $10,500, plus monthly allowance in local currency. If married, family separation of approximately one year before housing will be available. (*c*) Mechanical supervisors, to 40, at least two years college desired, and a minimum of ten years' practical field mechanical maintenance experience, with particular emphasis in diesel engines, pumps, electrical generators, and related auxiliary equipment. Will be responsible for efficient, economical, and uninterrupted operation of mechanical equipment at either pipeline pumping station or at the marine-terminal pumping station. $10,500, plus monthly allowance in local currency. If married, separation of approximately one year before housing will be available. Far East. F-5156.

Staff Editor, graduate mechanical preferred, advanced degree; some editorial experience with book publisher and a wide experience in the general mechanical-engineering field. Will cover meetings and contact outstanding mechanical engineers. $9000–$10,000. Va. W-5164.

Project Engineer, graduate mechanical, three

to four years' experience in process-plant engineering and maintenance and some plant-design experience. $7200–$8400. Company will negotiate fee. South. W-5169.

Manager, Engineering Standards and Specifications, BS degree, preferably in electrical, administrative, mechanical, or industrial engineering, broad knowledge of the physical sciences and definite leanings toward administrative phase of an engineering operation. Minimum of five years' experience as a standard engineer with an electrical manufacturer, or employment in some technical capacity, considerable knowledge of government specifications and standards. Background should include administrative or supervisory work. Must have a flair for writing. Will have direct administrative and technical supervisory responsibility for the performance of a group of standards engineers engaged in preparation of government and commercial standards and specifications; will train less experienced personnel; will serve on Standards and Specifications Committee, etc. $8400–$9600. Ohio. W-5176.

Manager, Industrial Engineering, ten to 15 years' experience, to develop an industrial-engineering department for large printing plant. $10,000–$15,000. East. W-5177.

Mechanical Engineers. (*a*) Hydraulic circuit designer, graduate mechanical, good analytical ability, strong in fluids, strength of materials, machine design, and mathematics. Must have five years' experience in design and development of hydraulic (oil) circuits. Experience in manufacturing processes of job-shop-type important. (*b*) Applications engineer for hydraulic application work for major sales division of leader in field. Good engineering background and experience needed. Interest, opportunity, plenty of work, and job responsibility. Conn. W-5186.

Administrative Analyst, 26–36, college degree. Prefer writing experience with analytical background in organization and methods. Must be familiar with administrative systems and procedures. Experience may have been in field of wage and salary, industrial training, or management consultant firms. $5940–$7620. South. W-5187.

Production-Planning Engineer, industrial or mechanical-engineering graduate, at least eight years' heavy machine-shop and metal-forming experience. $8000–$10,000. Western Pa. W-5191.

Sales Application—Instrument; 25–32, graduate chemical, electrical, or mechanical. Experience in chemical or petrol industries desirable, or some sales experience or definite desire and aptitude to sell and able to write reports for established instrument company, pneumatic, mechanical, or electronic control-instrumentation field. Limited travel. Car required. Five to six months' training in eastern plant; relocation cost paid. Arrange to interview throughout U. S. $5400–$6000, plus expenses and mileage. Pacific Coast. S-2927.

Engineers. (*a*) Field Sales-Instruments; 30–40, EE, ME, three to five years' sales experience required, preferably instrumentation field, six to eight weeks training. Sell users of instruments, equipment manufacturers using instruments as part of product, research laboratory, public utilities, consulting engineers. About $10,000. (*b*) Inside Sales–Instruments; 25–35, BS or some technical education or background. No experience necessary, will train. (no military obligation). Handle correspondence, telephone quotations, orders, resales of electrical and mechanical instruments, records, and controllers. Leads to outside field sales engineer. $5100–$6600, depending on qualification. Discuss payment of placement fee with employer. San Francisco. S-2951.

Power-Plant Engineer, ME, to 50, five or more years' in steam power-plant design or operation. Staff position. Set up preventative maintenance program, improve efficiencies, power-plant design, plant location, studies for utility. About $10,000. Employer will pay placement fee. Nev. S-2960.

Administrative Engineer, preferably BS Engineering or ME, 30–40, experience qualifying for high-level position overseeing research development and engineering operation of multiplant corporation. Experience with food desirable but not essential if man knows mass-production methods. $15,000, plus. San Francisco. S-2962.

Engineers. (*a*) Chief draftsmen-process equipment, machinery; two years college, engineering or working equivalent, seven to ten years' experience in drafting or engineering, minimum of three years' supervisory position for mechanical heavy equipment. About $9600. (*b*) Administration engineer, design engineering, thoroughly acquainted in schedules, budgeting, cost accounting, and engineering administrative duties. Act as administrative assistant to manager of engineering. About, $9000. (*c*) Structural engineer, two years college or equivalent. The last three or four years in plant or equipment structures. (*d*) Plate engineer, two years college or equivalent. Last three or four years in plant or equipment structures, specializing in plate work. Salaries, (*c*) and (*d*) $7200–$8400. San Francisco. S-3001.

Engineers. (*a*) Machine design-process machinery, equipment, BSME, five to seven years' experience in mechanical product design. Knowledge of mining equipment helpful. For heavy equipment design. About $8400. (*b*) Mechanical design-machinery, equipment, BSME or equivalent, must be thoroughly-qualified in design of thickeners. $8400–$9600. (*c*) Design-machinery, equipment, ME or equivalent. Must be thoroughly qualified in design of agitators. $8400–$9600. (*d*) Design-piping, ME or equivalent, thoroughly experienced in industrial or plant piping, experience in either chemical or oil industry. About $8400. San Francisco. S-3006.

Candidates for Membership and Transfer in ASME

The application of each of the candidates listed below is to be voted on after Aug. 23, 1957, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and •Transfers

Alabama

•Almond, Glenn C., Birmingham
Holley, James B., Chickasaw
•Spkir, William B., Birmingham

Arizona

•Grove, Robert J., Phoenix
•Long, Augustus G., Phoenix

Arkansas

Akins, James G., Hot Springs
Amis, William E., Camden
Causey, James C., Pine Bluff
Hughes, John E., Hot Springs
Reck, William E., Little Rock
Walthall, Norris M., Little Rock
Woodward, James H., Little Rock

California

•Altwein, Donald W., Los Angeles
Argo, William E., Monterey Park
Bagdon, Richard J., Los Altos
Biglieri, Natale J., San Jose
D'Elia, Robert A., San Mateo
Garrison, Joel F., Oakland
•Goitein, Ernest E., San Mateo
•Goldsmith, Werner, Berkeley
Greer, Harold, Hollywood
Harper, Leland M., Palo Alto
Hikido, Katsumi, San Jose
•Jennings, Francis H., Los Angeles
Koernig, George K., San Francisco
•Marshall, Robert L., Downey
Martin, Charles R., San Francisco
Pinel, Stanley I., Jr., Buena Park
Sirland, Henry J., Oxnard
Slobodchikoff, Nicholas A., San Francisco
Stone, Harold M., Compton
•Williams, Howard J., Los Angeles
•Zeile, John E., Jr., Los Angeles

Connecticut

Brighton, George R., Stamford
Gelmetti, Ricco J., Danbury
•Hanzalek, Frederick J., Suffield
Skibinski, Henry J., Stamford
Strickler, Richard S., Branford
Tiffany, Douglas B., Fairfield
Warren, Curtis, Orange
Whitten, Donald C., Waterbury

Delaware

•Fields, James B., Newark
Hogshead, Thomas H., Wilmington

District of Columbia

Roy, Manindra N., Washington

Florida

Dvjak, Richard C., Panama City
Holm, Carl H., Panama City
Johnson, Arthur G., Jr., Panama City
Lawson, Harvel T., Panama City
Russell, Arthur O., Sanford
Segler, Ralph J., Panama City

Georgia

•Leavengood, William H., Savannah

Idaho

Arbtin, Emil, Jr., Idaho Falls
Stonehocker, Van Tassell, Kimberly
•Wood, Roger J., Idaho Falls

Illinois

•Gedney, Jack R., Chicago
Kofodimos, Thomas J., Palos Park
•Mitchell, Paul A., Pekin
Nelson, John L., Dixon
•Nielsen, Milton R., Lombard
Shaw, Gregory L., Chicago
Speight, Wilson D., Peoria
•Young, Robert L., Evanston

Indiana

Erhardt, Joseph, East Chicago
•Hayes, Thomas P., Fort Wayne
•Kenney, John A., Fort Wayne
Luckett, Jack C., Connersville
•Round, Byron J., Munster

Kentucky

Durst, Sterling H., Louisville

Louisiana

Robbins, George P., Jr., New Orleans

Maryland

•Lyness, Arthur A., Jr., Odenton
Morris, Vernon M., Baltimore
Stine, Ralph E., Frederick

Massachusetts

Backer, Stanley, Waban
Berkowitz, Melvin H., Quincy
•Robinson, George Y., Jr., Cambridge
Stein, John M., Northboro

Michigan

Benson, Eugene M., Detroit
Foote, James H., Jackson
•Hall, Carl W., East Lansing
Stevens, John B., Birmingham
Tsien, Vee C., Kalamazoo
Vesy, Carl J., Wyandotte

Mississippi

•Baccich, George M., Jr., Jackson

Missouri

•Hadley, Stephen D., Kansas City

Nebraska

•Walters, Phillip R., Lincoln

New Jersey

Clarke, Frederick J., South Bound Brook
Deutsch, Fritz A., East Orange
Poss, Ira M., Ho-Ho-Kus
Salamon, Robert George, Passaic

New York

Andrews, Victor M., Pine Plains
•Beard, Richard D., DeWitt
Burwell, John T., Jr., New York
Campbell, James K., New York
Coutris, Achilles W., New York
•Feiner, Irwin S., New York
Frasso, Vincent J., Schenectady
•Fried, Lawrence, Utica
Friedman, Bertrand B., Bayside
Guthait, Manuel, New York
Holmquist, Eric A., Poughkeepsie
Koniewicz, Paul, New York
Miller, Gene M., Brooklyn
•Mollick, Leon, Elmont
Molter, Frederick J., Elmira
Nares, Harold E., Holland
Platts, George F., Liverpool
Polowe, Joseph, Rochester
Pompeii, Phillip S., 2nd, Binghampton
Powers, Whitney S., Jr., Elmira
Roberts, Robert G., Poughkeepsie
•Schwarz, George H., Long Island City
Sperman, Jacob H., Brooklyn
Stahlka, Walter E., Buffalo
Warner, Oliver Stanton, Thornwood

(ASME News continued on page 826)

•Transfer to Member or Affiliate.

COLOR-PORT

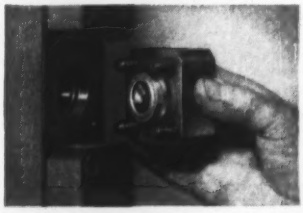
water level gage gives you . . two-color readings . . low maintenance . . increased availability

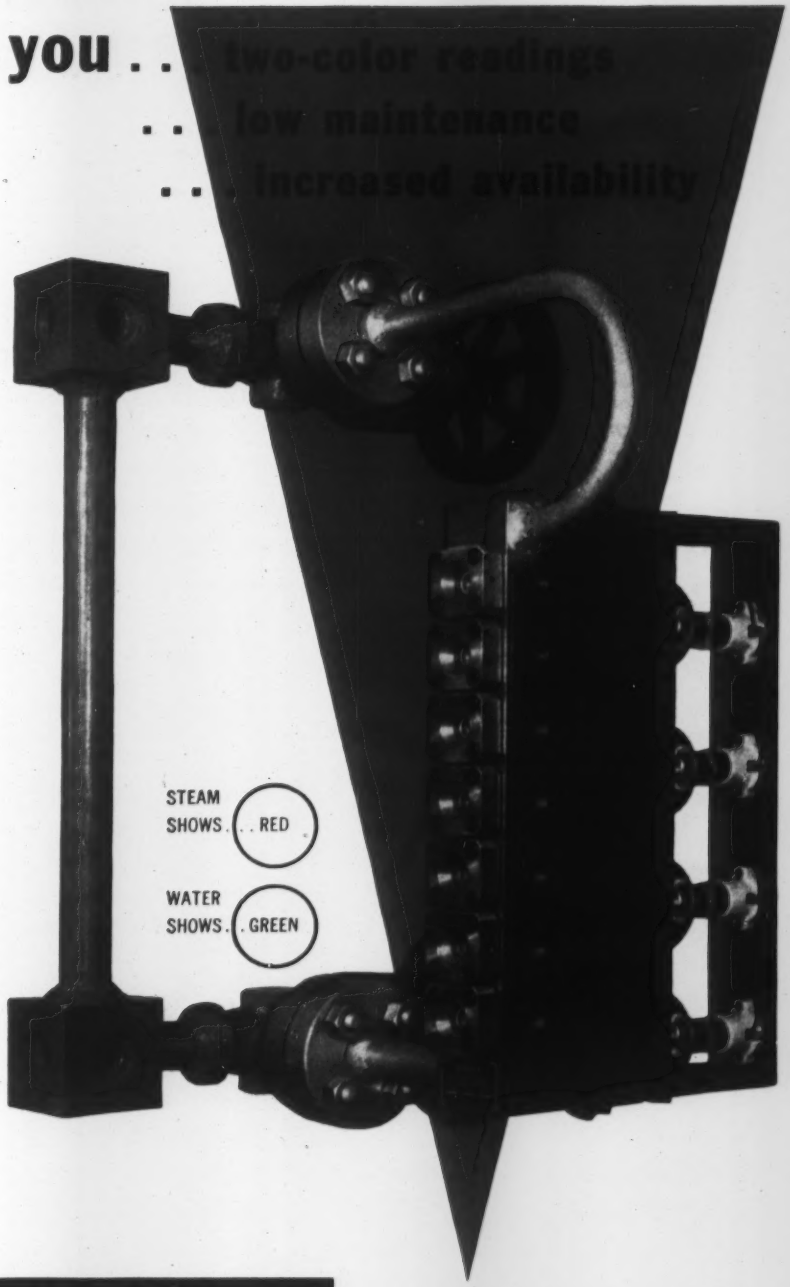
You get a *triple advantage* with the Yarway COLOR-PORT boiler water level gage for pressures to 3000 psi.

Two-color readings are brilliant and clear. Water shows green; steam shows red. A full gage is all green and an empty gage all red.

Low maintenance with individual cover-glass assemblies, each held solidly in place by four socket head cap screws. "Floating assembly" design applies safe, predetermined loads on glass ports, reducing thermal shocks, permitting faster warm-up.

Increased availability means longer service life. Cover glass assemblies can be *serviced in place*, easily and quickly.





Yarway Bulletin WG-1814 describes the Color-Port Gage. Write for it.

YARNALL-WARING COMPANY
108 Mermaid Avenue
Philadelphia 18, Pa.
Branch Offices in Principal Cities

YARWAY COLOR-PORT . . . a *good* way to specify high pressure water gages

ZAK, EDWARD, Corning

North Carolina

FOLSOM, NOEL J., Charlotte

Ohio

ATHERTON, NEIL P., Cambridge
BASTIAN, RAYMOND E., Akron
COLIJN, HENDRIK, Akron
DICK, WILLIAM M., Willoughby
●GRAM, ARTHUR J., JR., Alliance
HARTNETT, GEORGE J., JR., Barberton
●HULLEY, CLAIR M., Cincinnati
JONES, HARRY M., Canton
●MAIER, OTTO H., JR., Massillon
MENDEIROS, MANUAL F. D. S., Cleveland
RAAB, HERMANN, Cleveland
SEYLER, DONALD R., Cincinnati
SMITH, ALBERT J., Lancaster
WINCHELL, STERLING F., Cleveland

Oklahoma

HARDMAN, JAMES T., Tulsa
●LEE, JAMES H., Tulsa
WETZEL, KARL H., Oklahoma City

Oregon

DUFF, RICHARD A., Portland

Pennsylvania

●BARKAN, PHILIP, Philadelphia
BODDEN, HUGH E., Middletown
CESS, ROBERT D., Pittsburgh
CONNERY, LAUREN J., Library
COSTABILE, PHILIP A., Harrisburg
DAILEY, PAUL E., Erie
DE CERCHIO, VINCENT N., Reading
●DRUMMOND, DAVID Y., Pittsburgh
●HAGENBUCH, JOHN D., Philadelphia
KNORR, ATLEE M., Glenside
KRAPF, EARL F., Export
●LAWIT, ROBERT L., Philadelphia
MARTIN, EUGENE E., JR., Erie
MILLER, ROY R., Erie
PEPPER, ANDREW J., Pittsburgh
●PRICK, JAMES L., Pittsburgh
SHUGHART, WILLIAM F., New Bloomfield
SMEKKE, JOHN J., 2ND, Philadelphia
VAN VLACK, WALTER W., Pittsburgh

Rhode Island

BURTON, DONALD T., Providence

South Carolina

KIERSPE, GEORGE R., Aiken
●MATTHEW, ROBERT T., North Charleston
RACHAL, ERNEST A., Aiken

Tennessee

BUSH, JAMES O., Lowland
GARDNER, ROBERT M., Knoxville
●HOLZ, PETER PHILIP, Oak Ridge
●PREISENDANZ, EDWARD S., Nashville

Texas

HEAPS, NEAL BARTON, Bellaire
THOMAS, EDWIN F., Fort Worth
ZANOWIAK, PAUL P., Sweetwater

Utah

BEGIARIAN, NICOLA H. P., Salt Lake City

Washington

BROWN, JOHN W., Richland
KIRLING, WILLIAM C., Seattle
PORTER, WILLIAM W., Richland
WIRTA, ROY W., Richland

West Virginia

HANNOVER, FINN, Charleston
NELSON, JOHN F., JR., Charleston
RIMMER, HERBERT J., Nitro

Wisconsin

RIEGEL, HAROLD G., Milwaukee

Foreign

BOSE, ARUN K., Manchester, England
BROWN, NORMAN E., Toronto, Ont., Canada
BUKER, GERARDUS J., Germiston, Malvern, S. Africa
CARELLI, ALESSANDRO E., Torino, Italy
CHU, RICHARD O., Mandaluyong, Rizal, Philippines
DA SILVA, GEORGE N., Trinidad, B.W.I.
DOWSETT, FREDERICK C. A., Dagenham, Essex, England
FEKETE, LANCELOT A., Caracas, Venezuela, S. A.
FENG, CHI-ENG, Taipei, Taiwan, China
●FLOUNDERS, JOHN M., Montreal, Que., Canada
GENTLE, ALAN G., Ottawa, Ont., Canada
MENDIOLA, MANUEL M. JOSE, Montevideo, Uruguay, S. A.
MERLER, SCIPIO, Vancouver, B. C., Canada
MORITA, SABURO, Toronto, Ont., Canada
PATELL, DORAB P., Bihar, S.E.Rly., India
RAMAMOORTHY, NAGARAJA, Deep River, Ont., Canada
ROUNDILLA, FERNANDO S., Agana, Guam, M. I.

Transfers from Student Member to Associate Member, Class of 1956 2

Obituaries

Arthur Albert Archer (1893-1957), vice-president in charge of engineering, Mosebach Electric & Supply Co., Pittsburgh, Pa., died April 8, 1957. Born, Norristown, Pa., Nov. 29, 1893. Parents, Archie A. and Laura B. Archer. Education, five-year night course, Carnegie Institute of Technology, 1917. Married Alice Hulton, 1919. Mem. ASME, 1942. Mr. Archer, a specialist in the design of process apparatus for combustion and heat-transfer processes, held a patent for dry-cooling low-temperature coke. During 1951 and 1952, he served as coal-mining consultant in Europe under the Marshall Plan. Surviving him are his widow; a son, Howarth A. Archer, Walnut Creek, Calif.; and two daughters, Mrs. Helen E. Fardig, Fayetteville, N. Y., and Mrs. Sue Beth Fair, Summit, N. J.; two brothers, Harry V. and Lemuel R; and seven grandchildren.

Frederic E. Banfield, Jr. (1885-1957?), whose death was recently reported to the Society, was the retired vice-president and works manager of the Whitinsville Machine Works, Whitinsville, Mass. Born, Newton, Mass., June 21, 1885. Parents, Frederic E. and Gertrude (Danforth) Banfield. Education, PhB, Brown University, 1906; BS(ME), 1908; and studied at The Massachusetts Institute of Technology. Married Marguerite Birge, 1910; one son, Richard Wallace Banfield. Married 2nd, Alberta Hoeftman Powers, 1926. Assoc-Mem. ASME, 1909; Mem. ASME, 1918. Mr. Banfield served on the Board of Aldermen, Newton, Mass., in 1922; and was president of the Associated Industries of Maine in 1933 and 1935. A specialist in the design and manufacture of textile machinery, Mr. Banfield had been with the Whitinsville Machine Works from 1935 until his retirement.

Walter Russell Barkley (1896-1957), design engineer, General Motors Corp., Detroit, Mich., died March 10, 1957. Born, Parker, S. Dak., June 20, 1896. Parents, William H. and Mary Barkley. Education, BS(ME), Purdue University, 1923. Married Mildred Coe Larson, 1927. Jun. ASME, 1924; Assoc-Mem ASME, 1925; Mem. ASME, 1935. During World War I, Mr. Barkley served in the U. S. Army. He was a specialist in steam-power plant design, construction, and appraisal. Before his association with the General Motors Corporation, Mr. Barkley had been with the U. S. Government, Treasury Department, Bureau of Internal Revenue. He investigated engineering issues involved in the administration of income-tax laws. He is survived by his widow; and a daughter, Patricia.

Leroy Scott Bergeson (1925-1957), Sioux City, Iowa, died Jan. 6, 1957. Born, Sioux City, Iowa, July 16, 1925. Education, BA, Iowa University, 1950; BS, Iowa State College, 1956. Assoc. Mem. ASME, 1956.

Henry Edward Byer (1878-1957), consultant in the field of hydraulics and the inventor of Byer condensers, died April 20, 1957. Born, Astoria, L. I., Dec. 1, 1878. Parents, Herman C. and Anna R. (Nelson) Beyer. Education, ME, Cornell University, 1902. Mem. ASME, 1919. Married Helene Emma Lugrin, 1920. In 1910, Mr. Byer designed and built his first condenser which served a 500-kw General Electric Steam Turbine. As chief engineer for the Ingersoll-Rand Co. he was able to extend the use of his condensers to China, Japan, and the Philippines. While associated with the Chicago Pneumatic Tool Co., Mr. Byer developed several innovations in the design of barometric steam condensers. Mr. Byer later formed his own company and for 35 years developed and sold Byer Steam Condensers and allied products, notably the Byer vacuum fumigating equipment used in major ports throughout the United States. The patents which Mr. Byer held are numerous and included both counter current and parallel current flow condensers as well as scrubbers. Survived by his widow; a daughter, Mrs. Patricia B. Andrews, Salem, Va.; and a sister, Mrs. George L. Baker, Evanston, Ill.

Harry Beaver Canby (1877-1957), retired former president and secretary, The Crawford McGregor and Canby Co., sporting goods firm, Dayton, Ohio, died April 6, 1957. Born, Dayton, Ohio, Dec. 21, 1877. Parents, Edward and Ida (Beaver) Canby. Education, AB, Denison University, 1898; BS, Massachusetts Institute of Technology, 1902; one year of study at Harvard Law School. Married Hannah P. Forgy, 1905. Jun. ASME, 1904; Mem. ASME, 1917. Mr. Canby was active in civic affairs. A charter member of the Engineers' Club, he served as chairman of the organization's building campaign. For many years he served on the board of trustees of the YMCA, and three times headed the board. Survived by his widow; two daughters, Mrs. Howard N. Smith, Dayton, Ohio, and Mrs. Richard S. Fowler, Chicago, Ill.; and a son, Edward, Palm Springs, Calif.

Francis Alton Collins (1884-1956), sales engineer, Hoover Ball & Bearing Co., Ann Arbor, Mich., died Dec. 2, 1956. Born, Flushing, N. Y., April 20, 1884. Parents, Frank A. and Sarah Leverich (Peck) Collins. Education, BS(ME), Lehigh University, 1908. Married Sarah S. Butler, 1910; children Elizabeth and Leah. Jun. ASME, 1910; Assoc-Mem. ASME, 1917; Mem. ASME, 1935. Mr. Collins held patents for double thrust ball bearings. He did pioneer work in the application of ball bearings to machinery, and did original work in the development of graphical methods for cost comparison of ball bearings. He has published several articles on these subjects in the technical press. A registered engineer in the State of New York, Mr. Collins was also active in church, civic, and engineering organizations.

Eduardo Damaso Gonzalez (1903-1957), chief engineer, American Sugar Refining Co., Central Jaronú, Province Camaguey, Cuba, died April 9, 1957. Born, Cruces, Cuba, Dec. 11, 1903. Parents, Maximiliano and Aurelia (Rodriguez del Rey) Gonzalez. Education, BS(ME), Harvard University, 1927; EE, Massachusetts Institute of Technology, 1928. Married Anne Johnston, 1934; children, Nancy, June, Eddie, and William. Jun. ASME, 1931; Mem. ASME, 1938.

Paul Loveridge Heslop (1891-1957?) whose death was recently made known to the Society, had been a construction consultant with Empresas Electricas, Rio de Janeiro, Brazil. Born, Unadilla, N. Y., June 16, 1891. Parents, William Horsman and Sarah (Loveridge) Heslop. Education, CE, Cornell University, 1914. Mem. ASME, 1931. Mr. Heslop served in the U. S. Army Ordnance Corps during the first world war, and as a reserve officer for five years thereafter. He was a registered engineer in the States of Oregon and New York. Mr. Heslop has served the Society on the Hydraulic Prime Movers Committee, Hydraulic Division, until 1941; was Oregon chairman from 1937 to 1938; and in 1937 acted as first alternate to the national Nominating Committee, Group VII. He was also a member of the American Society of Civil Engineers.

Jerald Francis Jaeger (1923-1957), vice-president, Meridian Plastics, Inc., Byesville, Ohio, died March 29, 1957. Born, Stephenson, Ill., July 12, 1923. Education, BS(ME), University of Illinois, 1945. Assoc Mem ASME, 1945. Married E. J. Bozman, 1946; one son, John Christopher.

Wilhelm Jardh (1882-1957), retired designer, Douglas Aircraft Co., Santa Monica, Calif., died April 9, 1957. Born, Keylbo, Sweden, Sept. 18, 1882. Parents, Jan and Maria (Albertina) Östlund. Education, Kristinahamns Praktiska Skola, Sweden, 1906-1908; Pittsburgh Academy and night school, 5 years. Married Thina A. Johnson, 1913. Assoc-Mem. ASME, 1920; Mem. ASME, 1935. Survived by his widow; and a daughter, Mrs. Herman Quarnstrom, Cheverly, Md.

Carthrae Merrette Laffoon (1888-1957), consulting engineer, El Cajon, Calif., died April 5, 1957. Born, Coldwater, Kan., Aug. 14, 1888. Parents, Mark and Sallie (Brown) Laffoon. Education, EE, University of Missouri, 1914; MA, 1915. Married Kittie Kuhns Painter, 1917; three sons, Carthrae M., Jr., Christopher P. (deceased), and Louis M. Laffoon. Mem. ASME, 1944. Mr. Laffoon had formerly been connected with the Westinghouse Electric Corporation, and held positions from assistant to the chief engineer to manager of the generator engineering department. He was a registered engineer in the States of Pennsylvania and California. Mr. Laffoon had been the author of more than 20 papers which appeared in publications of ASME, AIEE, and the technical press. In 1950 he received the Lammé Medal; he also was the recipient of the Westinghouse Order of Merit. He was a member of Tau Beta Phi and Sigma Xi; and a Fellow, AIEE. In addition, Mr. Laffoon served for ten years as a member of the North Huntingdon (Pa.) Township school board.

Anthony A. Levata, Jr. (1918-1957), engineer, power-plant division, U. S. Naval Air Station, Pensacola, Fla., died April 2, 1957. Mr. Levata was born in New Orleans, La., Dec. 21, 1918. He studied at the Louisiana State University and in February, 1957, received a BS(ME). He became an Assoc. Mem. ASME in 1957.

John Bartine Lund (1900-1957), project engineer, General Motors Corp., La Grange, Ill., died April 7, 1957, in Camden, N. J. Born, Whiting, Ind., June 13, 1900. Parents, Erick

(ASME News continued on page 828)

REPUBLIC'S JOB

at Kyger Creek:

control five 1,400,000 lb./hr. boilers — automatically

Kyger Creek Power Plant of the Ohio Valley Electric Corp. is big—*a million kw capacity at 7 lb. steam per kwhr.* And its job, supplying the U.S. atomic program, is one of the most important in the world. Republic's job: Control each of the five 1,400,000 lb./hr. boilers *automatically.*

Republic's solution provides each boiler with a *load*-sensing combustion control, a follow-up *pressure* control, and an "Electronic Master". In operation, a change in steam flow (load) is detected and initiates a proportional adjustment of air and fuel flow *before the load change can change boiler pressure.* Should pressure tend to drift up or down, the follow-up control detects it and modulates the fuel/air control signals accordingly. The "Electronic Master" integrates all measured data and master-loads the unit's pneumatic power operators. It also provides adjustable automatic division of total fuel among the boiler's 14 burners in the desired proportions, and permits manual operation.

Perhaps your plant is smaller; perhaps it supplies process steam instead of feeding 200,000-kw turbines. Whatever the size or duty, Republic's experience (30 years of it) can help you get maximum stability and efficiency from your major equipment. *Always* check plans with Republic; our engineers can save you trouble and expense throughout the life of your plant.

REPUBLIC FLOW METERS CO.

A Subsidiary of Rockwell Manufacturing Company

2240 Diversey Parkway • Chicago 47, Illinois

and Belle (Jenks) Lund. Education, LLB. Cumberland University, 1932; BS(ME), Purdue University, 1937. Mem. ASME, 1946. Mr. Lund served in the U. S. Marine Corps during the first world war. Survived by his father; and a sister, Mrs. Rudolph P. Lange, Delavan, Wis.

Lester Felter Mitchell (1885-1957?), whose death was recently reported to the Society had been manager of the engineering and development division, Addressograph-Multigraph Corp., Dayton, Ohio. Born, Dayton, Ohio, Sept 5, 1885. Education, high-school graduate and YMCA night school. Mem. ASME, 1945. Mr. Mitchell was a specialist in the creation and development of control mechanisms. Previous to his 25-year association with the Addressograph-Multigraph Corp., Mr. Mitchell had been employed by the National Cash Register Corp.

Harvey Edward Molé (1869-1957), retired consulting engineer, died April 9, 1957, Summit, N. J. Born, Philadelphia, Pa., April 16, 1869. Parents, Harvey Edward and Amelia (Cartwright) Molé. Education, BS(ME), Cornell University, 1897. Married Vena Fenno, 1904; died 1953. Mem. ASME, 1901; Fellow ASME, 1941. During the early years of his career, which characterize his achievement throughout his lifetime, Mr. Molé was concerned with the construction and operation of electric power plants for railways and lighting; hydroelectric power plants; gas plants; industrial plants, and refrigeration and ice plants. From 1902 to 1906 with the British Westinghouse Electric and Manufacturing Company, London, England, he was the engineer in charge of the design, construction, and installation of eight power stations in the British Isles and India. In the years from 1906 to 1908 he was chief engineer with the Russian Westinghouse Company, St. Petersburg, Russia. He was responsible for the electrification of the St. Petersburg Municipal Railway. As a consulting engineer, Mr. Molé conducted investigations and evaluated and reported upon public-utility properties in 14 states. In 1916 the total replacement value of these properties was in excess of $120 million. Mr. Molé was also a Fellow of the American Institute of Electrical Engineers. He is survived by his son, Harvey Edward Molé, Jr.

James Carey Othus (1891-1957?), whose death was recently reported to the Society, had been associate professor of mechanical engineering, University of Portland, Ore. Born, Pueblo, Colo., July 15, 1891. Education, BS(ME), Cornell University, 1917. Mem. ASME, 1928. Mr. Othus served in the U. S. Army during World War I. He began his teaching career as professor of mechanics and materials at Oregon State College in 1921.

Roland B. Renner (1878-1957), retired sales engineer, West Palm Beach, Fla., died April 2, 1957. Born, Cincinnati, Ohio, Dec. 8, 1878. Parents, William F. and Charlotte (Borman) Renner. Education, BS(ME), Purdue University, 1904. Married Katheryn MacMahon, 1906. Jun. ASME, 1906; Assoc-Mem. ASME, 1915; Mem. ASME, 1927. Mr. Renner was an instructor in mechanical engineering at Cornell University from 1904 to 1906. In 1907 he joined the Jeffrey Manufacturing Co. and maintained a long association with that company. He held several patents for devices used in materials-handling equipment. Mr. Renner served the Society as a member of the Executive Committee of the Materials Division, and from 1937 to 1939 served as chairman of that Division.

Cyrus William Rice (1875-1957), chairman of the board of Cyrus Wm. Rice and Co., Pittsburgh, Pa., died April 29, 1957. Born, Ringtown, Pa., May 28, 1875. Parents, James Kennedy and Emeline (Fegely) Rice. Education, attended Jefferson Medical College, 1892–1894. Married Esther Knipp. Mem. ASME, 1915; Fellow ASME, 1951. Mr. Rice was a pioneer in the development of new methods for the treatment of river water and sewage for the internal treatment of boilers. The scientific methods which he developed formed the basis of current water-treatment technology. Mr. Rice held 15 patents pertaining to water-treatment methods. In 1916, after having been employed by the Colorado Fuel and Iron Co., the Carnegie Steel Co., and the Atlantic Refining Co., Mr. Rice established his own firm to supply consulting services on water-treatment problems. Among his many clients were the Allegheny Steel, American Sugar Refining, and Gulf Refining Companies. Mr. Rice served the Society as chairman of the chemical section of the Committee for the Care of Power Boilers. He was a charter member of the Engineers' Club of Philadelphia, Pa., and a member of the American Chemical Society. He was a sponsor of the Pennsylvania Aqueduct developed by C. C. Crick. The aqueduct provided a pure water supply and flood control for the Pittsburgh area. Survived by his widow; and three sons, William G., New York, N.Y.; James K., and Richard C. Rice, both of Pittsburgh, Pa.; five sisters; and three grandchildren.

David Jesse Weissgold (1897-1957), design engineer, Sperry-Rand Corp., Great Neck, L. I., died March 5, 1957. Born, Duluth, Minn., Aug. 7, 1897. Education, Cooper Union Institute, 1917. Mr. Weissgold had performed original design work on intricate military equipment involving the specification of materials, their strength, and their safety. Mem. ASME, 1957.

Harry Hamilton Wolfe (1897-1956), assistant chief engineer, The Buckeye Steel Castings Co., Columbus, Ohio, died Oct. 13, 1956. Born, Lancaster, Ohio, Nov. 2, 1897. Parents, Waldo and Nellie Wolfe. Education, attended Ohio State University, 1916–1917. Married Geneva Ida Wolfe 1919. Mem. ASME, 1946. Survived by his widow; and a daughter, Betty Lorival Abonaf, Fairborn, Ohio.

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print

ASME Master-File Information

Date

LAST NAME | FIRST NAME | MIDDLE NAME

POSITION TITLE | NATURE OF WORK DONE

e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) | Division, if any

*☐

EMPLOYER'S ADDRESS | City | Zone | State

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER, e.g. Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐

HOME ADDRESS | City | Zone | State

☐

PRIOR HOME ADDRESS | City | Zone | State

* CHECK "FOR MAIL" ADDRESS

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☐ MECHANICAL ENGINEERING	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ U—Maintenance and Plant Engineering
☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
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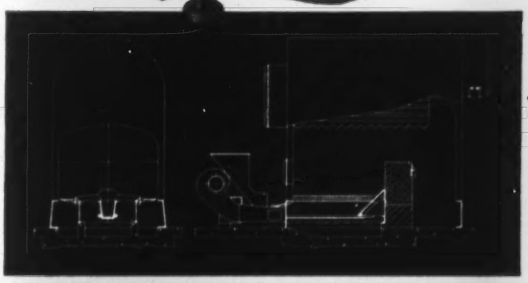
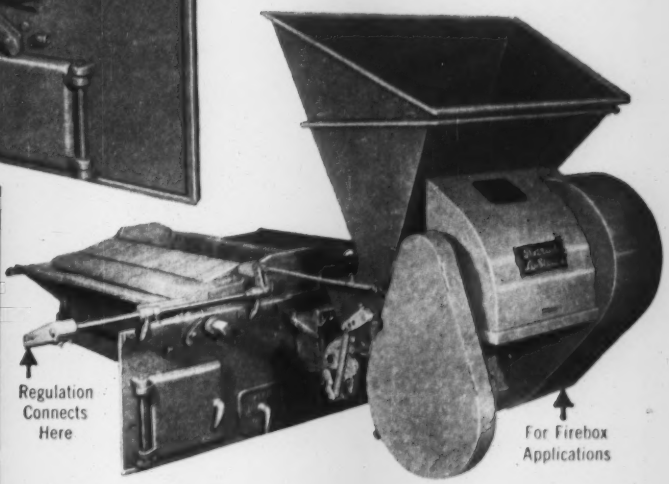
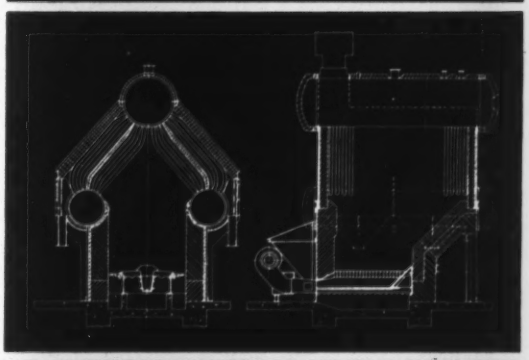
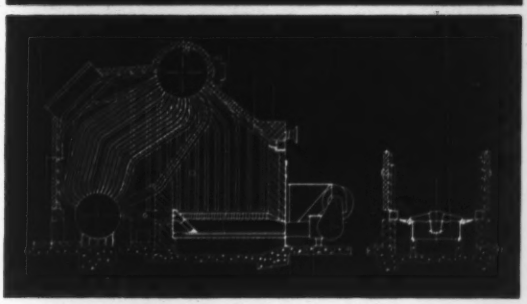




Regulation Connects Here

For Firebox Applications





A complete mechanical firing unit. The Detroit LoStoker is efficient, dependable and built for long life. Requires little power for operation, may be driven either by motor or steam turbine, under automatic control.

Optional regulation is "Start and Stop" or "Full Floating Control". With "The Detroit Adjustable Feed Control", the plunger always operates on a full stroke, which assures uniform distribution at all capacities.

Where furnace volume permits, the LoStoker may be installed directly in firebox boilers, without front or side-wall brickwork.

Typical applications to small boilers are shown.

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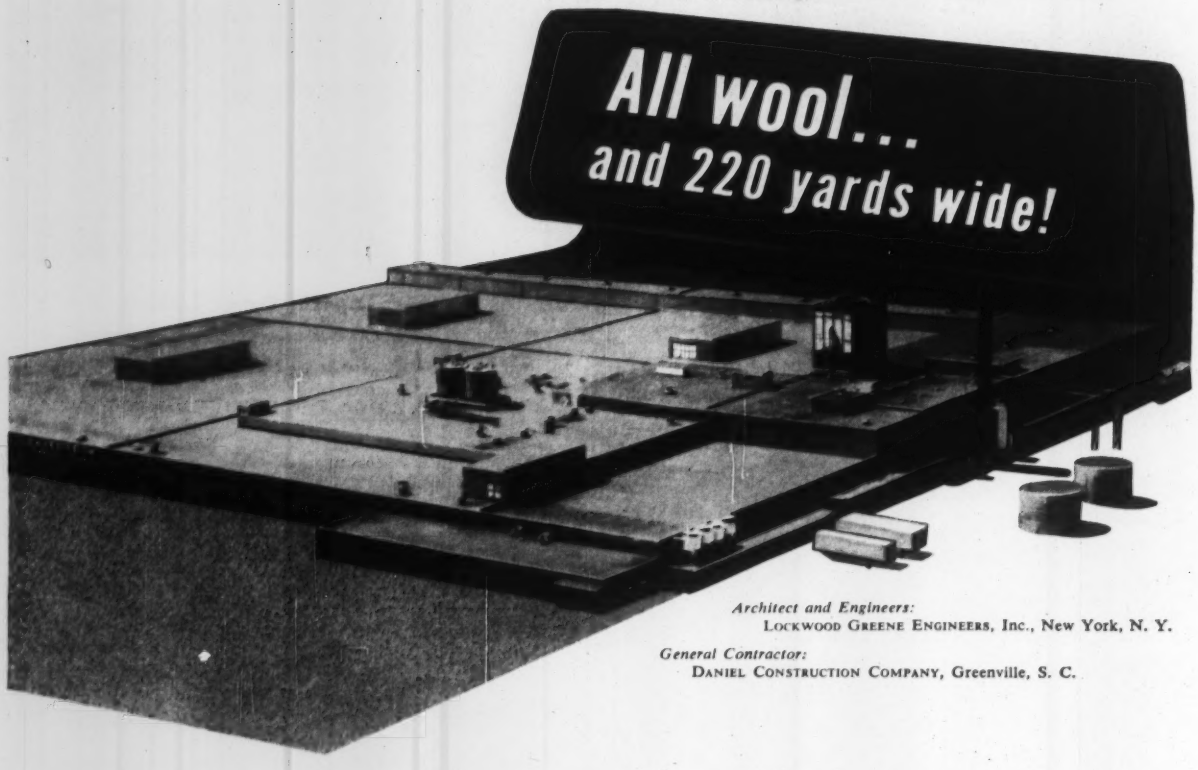


Architect and Engineers:
LOCKWOOD GREENE ENGINEERS, Inc., New York, N. Y.

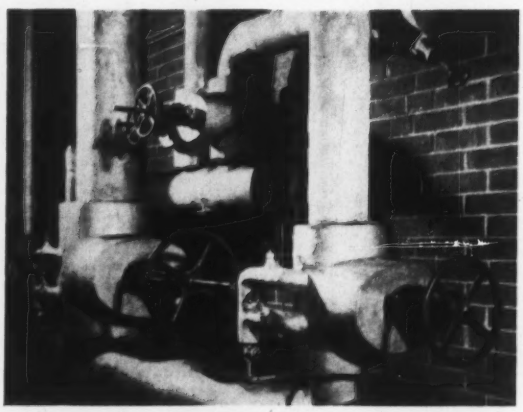
General Contractor:
DANIEL CONSTRUCTION COMPANY, Greenville, S. C.

Textron's first fully integrated woolen mill is equipped with **JENKINS VALVES**

The nation's largest woolen mill, with weaving, dyeing and finishing facilities all under one roof, occupies 430,000 square feet at Barnwell, S. C. This huge plant, operated by Amerotron Corporation, a Textron company, contains the most modern equipment that textile technology and modern engineering could provide. Utilizing U-shaped production flow, the Barnwell Mill achieves the utmost in economy of movement and handling of raw and finished materials.

The equipment for this ultra-modern, air conditioned plant was selected to match the efficiency and advanced concept of the building design. To control much of the complex piping system, Jenkins Valves were the unanimous choice of Textron's management and the engineers and contractor involved in this project.

Expectation of an extra measure of performance and economic service from Jenkins Valves has been universal among building experts and plant operating personnel for three generations. The symbol of this reputation is the famous Jenkins' Diamond and Signature trade-mark . . . and, moreover, the valves that bear it *cost no more.* Jenkins Bros., 100 Park Avenue, New York 17, N. Y.



Example of the wide variety of sizes and types of Jenkins Valves required to control the complex piping system of Textron's new Barnwell Mill.

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VALVES
TRADE JENKINS MARK SINCE 1864
Jenkins Bros.

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Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING.

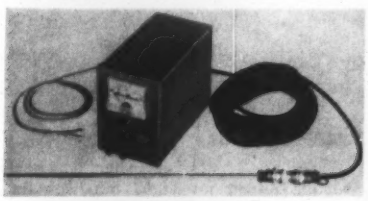
NEW EQUIPMENT

Secondary Capacitors

A new residential secondary capacitor design, available in 3, 5, and 7½ KVAR, 240-v ratings, is announced by General Electric Co.'s Capacitor Dept., Hudson Falls, N. Y.

The capacitors have a rectangular design to permit complete impregnation of each unit, thereby avoiding the possibility of internal failures caused by voids in the liquid dielectric, the company states. The flat sides also allow the unit to expand to contain any internal pressure caused by normal temperature rise during operation.

The new units can be mounted in any position.



Hot Wire Anemometer

A constant temperature hot wire anemometer is now being produced by Aero Research Instrument Co., 315 N. Aberdeen St., Chicago 7, Ill.

The company says the instrument features a new concept in that the constant temperature operation has greatly simplified its use. This, the firm states, makes the instrument available for industrial use.

It has a frequency response of dc to 1000 cps and a noise level of less than 1 per cent of the mean flow level.

By constant temperature operation the maximum sensitivity can be realized with minimum wire burnout, the company says. Operation is automatic and time constant testing or gain settings are not required. This affords self-regulation over a wide range of flow. The unit requires no batteries and three can fit into a 19 in. panel rack.

Output impedances are 10K and 100K ohms. Other systems for use to 60,000 cps are also available.

Carbide Tool Lathe

A 50-in. engine lathe, the Niles A-50, developed for high speed, high horsepower service with modern carbide tooling, has been introduced by Hamilton Div., Hamilton, Ohio, Baldwin-Lima-Hamilton Corp.

It is said to be capable of accommodating a drive motor up to 100 hp. The unit can be furnished as a standard turning lathe or a combination boring and turning machine. Other options include use of either mechanical or electronic feeds and with or without thread cutting.

The lathe has a 50-in. diam faceplate and swings 38 in. over the carriage bridge, 52 in. over carriage wings and bed.

The headstock has a high and low range of speed gears. Standard feed and thread range can be obtained without gear changing at the headstock end, it is reported. The unit is furnished with a lubricating pump and can be equipped for tail stock power traverse and power movement to the tail stock quill. Spindle speed ranges from 1.5 to 35.1 rpm through faceplate drive, 40.2 to 182 rpm through spindle drive.

Range of feeds is .0025 to .625 in. per faceplate revolution for longitudinal, .0012 to .312 for cross.

End gearing is arranged so that special feeds or threads can be obtained by using special gears. The headstock also is set up for cutting coarse leads. Feed take-off is on a faster running shaft to avoid excessive speed-up from the spindle to the feed box.

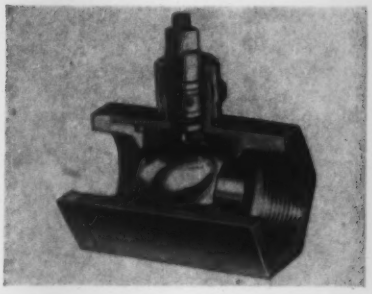
Self-Cleaning Filter

A new dual purpose, fully automatic filter with interchangeable filter elements is available from Bowser, Inc., 1300 E. Creighton Ave., Fort Wayne, Ind.

The new filter, when equipped with filter elements designed for lubricating oils and similar liquids, is designated as Figure 822. When containing filter elements suited to coolants, it is designated as Figure 823.

Both types of elements are interchangeable within the filter case. The filter media of the Figure 822 is constructed of wire-wound stainless steel or bronze, wrapped around a cast iron core, with a port opening range of .002 to .015. Figure 823 offers a porosity range of .020 to .045, utilizing a brass perforated sheet as filter media.

An interval repeat timer is provided for automatic self-cleaning and to permit adjusting the length of the cleaning cycle from a minimum 20-sec to a maximum 30-min period.



Vacuum Ball Valves

A line of high vacuum ball valves is announced by NRC Equipment Corp., 160 Charlemont St., Newton Highlands 61, Mass.

The valves are available in sizes from ¼ to 6 in. in either manually or air motor operated models. They can be made of bronze, aluminum, mild steel, 303 or 316 stainless steel or polyvinyl chloride. All valves are tested for vacuum tightness on a helium sensitive mass spectrometer leak detector, the company reports.

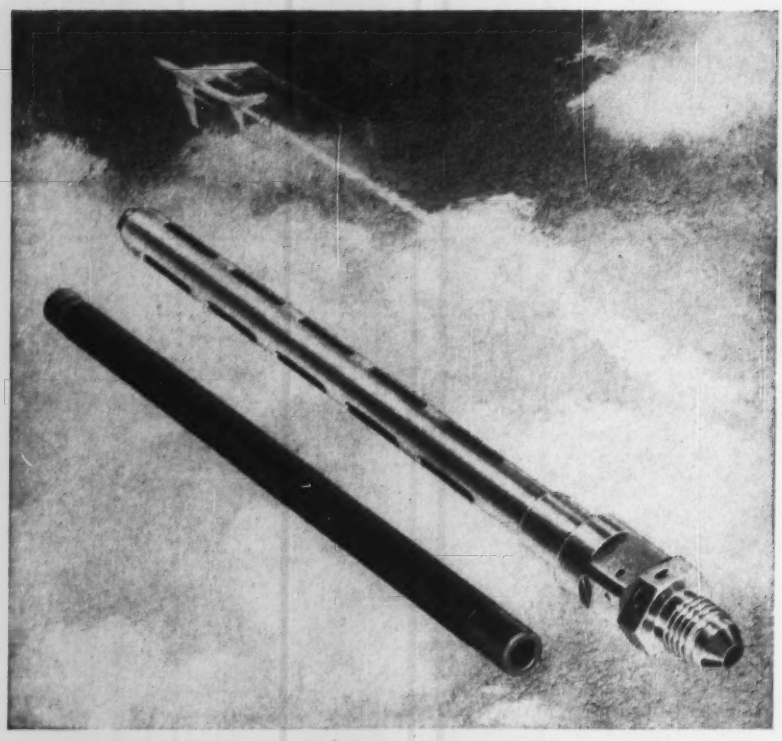
According to the firm, the valves will hold vacuum in either direction and are light and compact allowing mounting in any position. One quarter turn of the stem provides rapid opening and closing, and permits precise throttling, it is stated. In the full open position, the cross section is circular and approximates the size of connecting pipes.

Improved Cup Design

A new line of cups and packings said to offer greater service life through improved design has been announced by Chicago Rawhide Mfg. Co., 1301 Elston Ave., Chicago 22.

Made of elastomer impregnated mechanical leather, the cups are pre-formed on special dies to produce a sharp, rather than round heel. Advantages of the new molded design, according to the firm, are greater density at the heel of the cup, and the fact that the cups are pre-formed to the shape which conventional, round-heel cups are forced to assume under pressure of application. This eliminates operational stress and flexing that conventional cups undergo, and contributes greatly to service life, the company states.

Experience with the new molded cups in the field, in heavy duty applications such as farm and road building equipment and steel mill equipment at oil pressures up to 3500 psi, and in air cylinders at 150 psi has definitely established their greatly increased service life, the company reports.



"FEVER THERMOMETER"

for supersonic jets

In order to break sound barriers, jet engines must break some temperature barriers, too—which brings some real problems in material selection. Any thermostatic control in the jet stream must withstand temperatures of 2000° without significant change in properties and characteristics.

Faced with this problem, one of the world's leading designers and manufacturers of aircraft components and systems has made Kennametal* a "Partner in Progress"—and has found an answer. For a vital part of the sensing element in a thermostat assembly, a small tube of Kentanium* is used. This material, one of a big family of unusual carbides developed by Kennametal, retains its responsiveness and reliability through the entire flaming range of operating temperatures.

Perhaps you have some new product in mind that is still on the drawing board for want of materials with the necessary properties to meet an unusual operating condition. If you need superior corrosion or erosion resistance, hardness, strength and stiffness, or resistance to elevated temperatures, chances are you can find the needed combination of properties in the Kennametal line. Just write, outlining your problem, to KENNAMETAL INC., Department CE, Latrobe, Pa.

*Kentanium and Kennametal are the trademarks of a series of hard carbide alloys of tungsten, tungsten-titanium and tantalum.

C-3044A

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KENNAMETAL
...Partners in Progress

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Formula Board

A new formula board resembling a simple cribbage board has been introduced by Richardson Scale Co., Clifton, N. J. as a means of achieving complete automation in the program control of batching operations, it was announced here by the company.

When the formula board is used for presetting weight data in an automatic proportioning panel, it eliminates the need for manual weight settings and the possibility of human error in electronically controlled operations involving the proportioning of bulk materials, the company reports. The combination board and panel are used as components in the firm's Select-O-Weigh system, which provides automatic control over storing, feeding, conveying, weighing, mixing and discharging of bulk ingredients.

Typical applications of the system would include the formulation of feeds, bakery ingredients, rubber compounds and a variety of mixes for chemical processing operations, the company states.

Phenolic Tubing

A new line of small diameter, paper-base phenolic tubing for high strength, press-fitted mechanical and electrical assemblies is now available from National Vulcanized Fibre Co., 1057 Beech St., Wilmington 99, Del.

Designated as Phenolite Grade XX-3113, the rolled tubing is recommended by the company for use where metal tubes or studs are to be inserted into tubular plastic insulators, such as in brush holder assemblies, insulated bushings and other applications calling for press-fitted assembly.

The tubing is available in inside diameter sizes ranging from .093 in. min to .379 max; in wall thicknesses from .010 to $^{5}/_{64}$ in., depending upon piping size; and in lengths up to 35 in.

The tubing has a natural color. Typical radial compression values are: 179 lb for .104-in. ID by .164-in. OD tubing; 152 lb for .131-in. ID by .187-in. OD tubing. The material has an axial compression strength of 17,100 psi, a density of from 1.20 to 1.25 gm per cc, and a water absorption gain of from 5.10 to 5.65 per cent. This grade meets NEMA specifications for grade XX rolled tubing, the firm reports.

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NEW EQUIPMENT
BUSINESS NOTES
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Transistorized Computer

Ramo-Wooldrige Corp., 5730 Arbor Vitae St., Los Angeles 45, Calif., announces the development of an advanced digital control computer designed to provide fully automatic control for industrial process plants.

It is designated RW-300, and is designed to control such industrial processes as oil refining, chemical manufacturing, paper manufacturing and metals processing. The computer can also be used for general purpose scientific computation and to perform the monitoring function of a data logger, the company states.

As a central unit of a process control system, the firm says, the new computer will automatically read process instruments, perform the computation necessary to relate these readings to process objectives, determine the control actions and activate process mechanisms or adjust set points on supervised control loops.

Recording Oscillograph

A recording oscillograph which can record simultaneously up to 16 channels of phenomena at frequencies as high as 100,000 cps with exceptional clarity on a single 8-in. wide record, is available from the Miller Div., Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

It is designated as CR-1B cathode-ray recording oscillograph. Designed for extreme accuracy, simple operation, and dependability, the unit is a complete, high-precision recording system which includes its own power supplies, pre-amplifiers, deflection amplifiers, and recorder. Unusually stable circuitry and a precision optical system is claimed to combine to provide precise, drift-free signals recorded as traces comparable to those obtained on galvanometer-type recording oscillographs.

Eight dual-gun, cathode-ray tubes are used. Traces developed across the faces of the tubes are sharply focussed by the optical system and recorded on photographic film or paper. There is a dual display, with an access door providing convenient viewing of the sixteen traces, while the optical system reproduces the traces in sharp focus and beams them onto photographic paper or film.

Eight speeds, from 3 to 400 in. per sec, may be selected through front-panel push-buttons, which actuate separate magnetic clutches. No gear or pulley changes are required. Continuous 400-ft records can be run, or shorter records from 1 to 50 ft long can be taken automatically by means of a preset length selector. Standard commercial film and paper are used.

Other features include a continuous-sweep generator, adjustable from two to 30,000 cps, used as a time-base for single-sweep photography and as an aid in viewing traces during preliminary adjustments. Power supplies, including high-voltage, contain magnetic-amplifier and/or electronic-type regulators to insure maximum stability.

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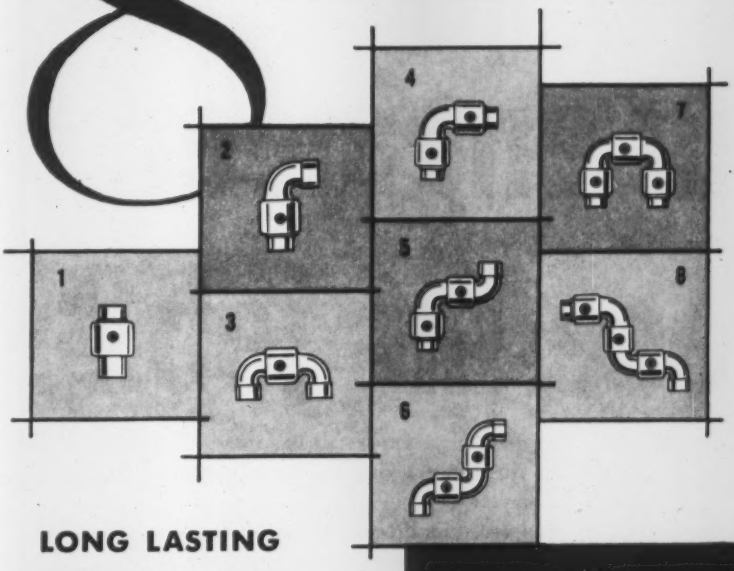
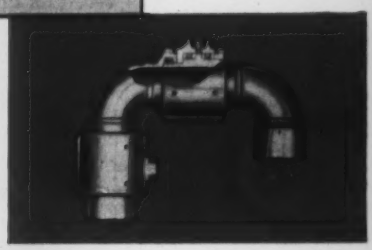
OVER 500 MODELS

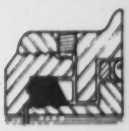


LONG LASTING
CONTINENTAL-EMSCO
SWIVEL JOINTS

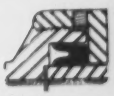


Continental-Emsco Swivel Joints are manufactured in all popular sizes for practically every type of service; from high vacuum to pressures of 15,000 psi, and from sub-zero temperatures to 750°. You can service a Continental-Emsco Swivel Joint without removing it from the line. Just break the joint as you would a pipe union. Packing is then readily accessible and can be replaced when necessary. No expensive returns to factory for repair.

Call or write today for complete information.



Grooved packing for high temperatures or corrosive services.



Lip type packing for both high and low pressures.

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How does an engineer lose his job?

Hundreds do it every day . . . without ever leaving the company. They become slip-stick artists, pencil pushers, glorified draftsmen. Unpleasant, yes, but easy to avoid. Selecting the *right company* makes the difference.

Take the Tonawanda Engineering Laboratories of LINDE for example. LINDE engineers have draftsmen to do their drawings . . . technicians to do their bench work. Each man shares his office with only one or two others. This atmosphere, free of tiresome chores, encourages the solution of tough engineering problems . . . makes it easier to demonstrate qualities for advancement.

This is pretty heady stuff . . . and not every engineer can qualify. The work is in the production and distribution of atmospheric gases as gases and as low temperature liquids. The background required is in thermodynamics, heat and mass transfer, and stress analysis as applied to pilot plants, equipment development, process engineering and plant design.

There are a limited number of important opportunities available now. If you consider yourself one of the better engineers, write to Mr. R. P. Kalle, Dept. ME-8, Linde Company, Division of Union Carbide Corporation, P. O. Box 44, Tonawanda, N. Y.

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Pump, Driving Motor Units

Tuthill Pump Co., 939 E. 95th St., Chicago 19, Ill., announces a series of positive displacement pump-and-driving-motor units.

These are offered for singular plant applications which do not warrant custom design and, according to the firm, can be used in varying combinations for hydraulic, oil burning, lubricating and other services involving many different fluids.

The pump-and-driving-motor units are close-coupled, with the pump mounted on the motor to eliminate the need for coupling, adapter or base.

In comparison with a regular assembly the new driving unit saves a minimum of 6 in. in space and weighs several pounds less, the company reports. The rotary positive displacement pumps used in these driving units range in flow capacity from 20–300 gph and in pressures up to 1500 psi. The combinations include 1/4 hp motors and larger.

Rectifier Junctions

A new series of 330-amp germanium power rectifier junctions, has been announced by International Rectifier Corp., El Segundo, Calif. This series of six types is rated at 330 amp rectified output current at voltage ratings from 20 to 66 v rms.

According to the company, the low current density, high capacity junctions feature corrosion and moisture resistant cast-aluminum housings with airfoil type cooling fins for maximum heat dissipation. Efficiency is rated to 98.5 per cent.

Six 330-amp germanium junctions connected in a three-phase bridge circuit will deliver 85 kw, (1000 amp at 85 v) while occupying only 1/2 cu ft, the firm states. Compared with conventional rectifiers of the same rating, the new units offer a 4 to 1 savings in weight, and more than a 16 to 1 reduction in cubic space requirements, it is claimed.

Use a CLASSIFIED ADVERTISEMENT *for Quick Results*

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NEW EQUIPMENT
BUSINESS NOTES
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Collared Screw Heads

Collared screw heads are now available on the entire line of Sure-Tite stainless steel hose clamps, made by Wittek Mfg. Co., 4305–37 W. 24th Place, Chicago 23, Ill.

The clamps, series C-S, with collared screw retain the screw driver from slipping. Series S, with deep slotted screw does not limit the size of screw driver, the firm reports.

Small Filters

R. P. Adams Co., East Park Dr., Buffalo, N. Y., has redesigned its line of small filters to provide a 75 per cent increase in filter area.

The WJR-1-A filter now has 3.5 sq ft of filter area without an increase in floor space requirements, the firm reports. It is available in both carbon steel or stainless steel with Poro-stone, Poro-carbon or Poro-screen elements. Bulletin 615, released by the company, provides specifications, dimension drawings, cross section views, and typical systems.

Stressed-Panel Fastener

A patented quick-action stressed-panel fastener that is claimed to withstand high shear and tensile loads, lock positively in less than one-half torque-free turn and compensate automatically for sheet separation resulting from warpage or deformation in the panels being secured has been developed by Waldes Kohinoor, Inc., Long Island City, N. Y.

The device is intended for use on structural load-carrying panels in aircraft, guided missiles and other applications where quick access to service areas is required.

The fastener has been used with satisfactory results on a structural fuselage panel of a B-47 bomber during test flights conducted by the Air Force, the company states. It exceeds the strength specifications of National Aircraft Standard No. 547 and, according to the firm conforms to the airframe industry's so-called "idiot-proof" operating requirements.

The unit, called QAF, has two major components: a retained stud assembly and a receptacle assembly. The stud assembly, available in both a flush and protruding-head type, is held in the panel by a retaining ring. The receptacle assembly is riveted to the air frame.

The fastener is engaged by pushing the stud—a high lead screw with a deep No. 2 Phillips recess—into the receptacle by hand or with a screw driver. An audible click indicates the stud has been secured in a split nut in the receptacle and that the panels being fastened are held in place loosely, the company explains.

The split nut moves in a tapered housing. As the screw is turned the nut is wedged into the narrower part of the housing until it is locked in place. Less than one-half torque-free turn is required to lock the fastener.

To disengage the stud and receptacle the procedure is reversed.

time to re-examine

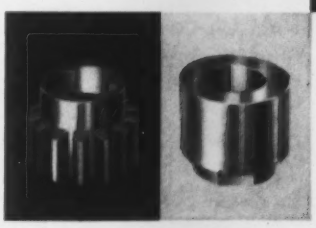
BEARING APPLICATIONS

Striking cost reductions in bearing applications in many mechanical products are made possible by the use of Bunting Sintered Powdered Metal Bearings and parts.

Bunting engineering counsel can guide you in the selection of designs and alloys that will provide bearings of exactly the type, design and material that will fully meet both cost and functional requirements, whether the material be Cast Bronze or Sintered Metal.

A competent group of Bunting Sales Engineers in the field and a soundly established Product Engineering Department put at your command, comprehensive data and facts based on wide experience in the designing and use of Cast Bronze and Sintered Powdered Metal Bearings and parts.

Write for catalogs and your copy of the new 24 page Bunting Engineering handbook of Sintered Powdered products and their composition, manufacture and application.



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. . . PUT UP THE WIND SHIELD, NELLIE

When the going got dusty back in 1907, Nellie had to put up the "wind shield" on this early Pope-Toledo. Mamma was too busy with spark, throttle, mixture, lubricator, cone clutch, progressive shift, bulb horn, two-hand steering and hand-and-foot brakes to do that too. And can you imagine what that gritty, billowing dust did to the EXPOSED *gears*, protected only by some sticky, poor-grade grease? No wonder tolerances were generous — and gear life short!

Into this pioneering atmosphere plunged John Christensen and Soren Sorensen, to start in the gear business. The problems that faced them then were different than those we face today, but we still adhere religiously to their formula for meeting them — do the best job possible every time, and be sure it's done a little better than anyone did it before. We think that's the main reason we've built up such a satisfied list of steady customers over the past 50 years. We'd like to add *you* to this list too — why not give us an opportunity on your next custom gear order?

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Fifty Years of "Gears — Good Gears Only"

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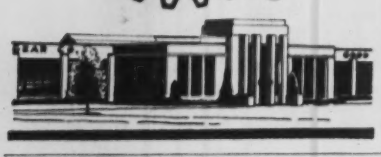

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Rotary Index Machine

A high production eight-station rotary index machine said to position accurately and perform machining operations on the bore and hub face of production parts by means of automation devices is now available from Expert Automation Machine Co., 17144 Mt. Elliott Ave., Detroit 12, Mich.

According to the company, the machine was designed for minimum floor space, and will spot face, ream, bore and bearingize the sintered iron bore and thrust face of 6-in. diam plastic automotive water pump impellers at a production rate of 700 pieces per hour at 80 per cent efficiency. By changing the fixtures and heads, the machine can be adapted to both large and small parts requiring accurate machining operations, the firm states.

The machine features 16 overcenter toggle type clamping fixtures (two per station) which automatically center and square the part and clamp it in position prior to the machining operations. An expandable rubber automatic unloading mechanism removes the part from the fixtures after all machining operations have been completed. All machining heads are mounted on standard way units. These electrically controlled and hydraulically operated way units have an advance and return rate of 300 in. per min and a thrust of 7000 lb. The way unit feed valve and hydraulic cylinder are manifold connected to an internally drilled manifold block. The company states that this design eliminates all piping within the unit which reduces the possibility of leakage and permits rapid replacement of the feed valve or hydraulic cylinder without making or breaking any hydraulic pipe connections. Six adjustable dogs control the way unit operation.

The index table is driven by a standard cam index mechanism with a mechanical shot pin. The high torque rating of this mechanism permits the indexing of the 2500 lb table (including fixtures) from station to station in $1^3/_4$ seconds without any shock or impact. The cam index mechanism is driven by a gear reducer and a 2-hp electric motor. Because of the cam design, starting and stopping loads on the motor reflect only the cam system inertia and not the table inertia.

During the automatic index from one station to another, the shot pin retracts and the table then raises, indexes and lowers into the next station. The shot pin then moves into position and accurately locates the table in station. This raise-index-lower design of the indexing sequence prevents skidding of the table on the reference pads and eliminates pad wear, it is claimed.

Repulsion Start Motors

Wagner Electric Corp., 6400 Plymouth Ave., St. Louis 14, Mo., announces its repulsion-start induction single-phase motors, in integral horsepower four-pole ratings 1–5 hp, are now being built in new NEMA frames 182–254U.

Placing these motors in the new frames making them interchangeable with capacitor-start and small polyphase motors of the same ratings, was accomplished without changing in any way their electrical characteristics, the firm says.

Tube Threading Tool

A tool made specially to thread three sizes of brass tubing, and a holder said to insure a proper grip on the tubing being threaded, are now available from the J. A. Sexauer Mfg. Co., 2503-05 Third Ave., New York 51, N. Y.

The tool has three dies that cut a 27 thread per inch on 1, $1^1/_4$ and $1^1/_2$ in. brass tubing. The tool's 1 and $1^1/_4$ in. dies have six cutting lands; the $1^1/_2$ in. die has eight cutting lands.

The companion unit, the 5-in-1 tubing holder, grips $^1/_4$, $^5/_{16}$, 1, $1^1/_4$ and $1^1/_2$ in. tubing in a rigid position for either threading, cutting or flaring. It consists of two parts locked together by wing nuts and, when clamped in the jaws of a vise, holds the tubing firmly without damaging or distorting it.

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only 25c

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This 15" circular Slide Rule has complete instructions printed on the face. Includes an Area Index (rarely found on slide rules). Reverse side converts gals./min. to cu. ft./sec.; btu./hr. to h.p.; many others . . . 48 conversions in all. Find your answer in one quick operation. It's a real help in many ways. Well made with plastic hairline. Limit, one to a person.

Gentlemen: Please send me one 15" circular slide rule and conversion calculator as advertised. My 25c is enclosed.

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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Vibration Isolation

Vibration Mountings, Inc., 98–17 50th Ave., Corona 68, N. Y., announces Shear-Flex mounting pads designed to reduce noise and isolate the vibration transmitted from industrial machinery, office and air conditioning equipment.

The material is available as 18 in. square by 3/8 in. thick oil-resistant neoprene sheet with a cross-ribbed structure said to offer excellent deflection throughout the full load range of 5 to 70 psi. According to the firm, light loads ride on the high ribs and heavy loads are supported by the entire ribbed surface. The recommended loading is 50 psi, the maximum impact load. The material can be used in multiple layers with the ribs crossing at right angles, it is reported. Installation is accomplished by cutting to size with a scissors or knife and placing the material under the equipment's legs or bearing plate.

Atmosphere Generators

A new line of controlled-atmosphere generators, available as completely packaged units with standard capacities of 750, 1000, and 1250 cu ft per hr, is announced by Eclipse Fuel Engineering Co., Rockford, Ill.

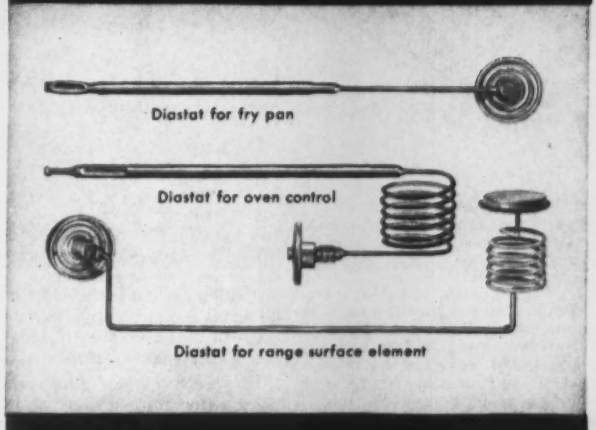
According to the firm, the Clean-Line generator produces an endothermic atmosphere with a low dew point and a gas analysis that is approximately 40 per cent hydrogen, 20 per cent carbon monoxide, with the balance nitrogen.

Gas and air are measured by separate flowscopes and are mixed in an air-gas mixer equipped with a manual ratio adjustment. The air-gas mixture is pumped by a booster through a fire check and into the retort.

Retort heating chamber is lined with insulating firebrick and holds an inconel retort filled with catalyst. Operating temperature of the retort heating chamber is 1800 F. Here the air-gas mixture forms the endothermic atmosphere and is piped through a cooler. The generator is provided with a manual preset regenerating valve so that carbon may be burned away from the catalyst periodically.

The generators are supplied with all components completely piped. Gas fuel for the generator passes through an Eclipse lock-tite safety valve and is then piped to the burner assembly consisting of mixer, automatic pilot, and control valve for heating the retort.

APPLIANCE DESIGNERS
investigate the advantages of
DIASTAT
Sensing Elements



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- GRILLS • WAFFLE IRONS • BROILERS
- RANGE SURFACE ELEMENTS • OVENS
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For designers seeking savings, Bridgeport Diastats permit elimination of ambient temperature compensating devices. The large ratio of bulb volume to diaphragm volume makes such costly extras unnecessary.

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Dual Stage BURNERS

Now, at last, the inherent advantages of *both* systems of fuel oil atomization are *profitably* yours . . . within the one, new NATIONAL AIROIL Dual Stage Burner.

45 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . . and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H.R.T., Scotch Marine and Water Tube Boilers; etc.

Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g.p.h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get detailed descriptions, illustration, and specifications in NATIONAL AIROIL Bulletin 25.

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KEEP INFORMED — NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Precision Oiler

A precision-made oiler, designed like a fountain pen to deliver exact amounts of oil as small as a fraction of a drop, is now available from Dill Mfg. Co., 700 E. 82nd St., Cleveland, Ohio.

It operates in holes up to $^{7}/_{8}$ in. in depth and other out-of-the way places ordinarily difficult to reach, the firm reports. The oiler can be used either vertically or horizontally for both holes and surface application. The oil supply is clearly visible in the transparent reservoir, and one filling is designed to provide a supply for unusually long periods.

In operation, the spring controlled steel point of the unit is pressed against the spot to be oiled, then released. A fraction of a drop is thus automatically ejected.

Shell End Mills

A group of Series 400, three-flute carbide tipped shell end mills, has been announced by Nelco Tool Co., Inc., Manchester, Conn.

The new shell end mills, for use with standard type C arbors, have been designed for face milling operations and finer finish on aluminum, magnesium, brass or bronze alloys and plastic materials.

According to the company, the three tooth design in the cutters allows more room for chip flow and the odd tooth construction results in a superior finish on such soft materials as aluminum and aluminum castings.

Multi-Point Recorder

A new model, 6705, strip chart multiple point recorder is announced by Weston Electrical Instrument Corp., Newark 12, N. J. It is designed to record up to 24 points on one instrument.

The case width is $17^{3}/_{4}$ in. to fit standard radio racks. The unit operates on the null balance principle, and all components are grouped in the simplest, most efficient, most serviceable manner, the firm states. In addition to plug-in range clips it also features changed chart speeds, and a simplified method of changing printing speeds, the company says. Alarm switches which can be added, can be set in a few seconds, and are made selective by additional decks on the multiple switch. Multi or unicolored numbered dot printing and internal fluorescent lighting are available.

PREFERRED Limits and Fits for Cylindrical Parts

Developed for use wherever it might serve to improve and simplify products, practices, and facilities, this American Standard:

lists and defines the terms applying to fits between plain (non-threaded) cylindrical parts,

presents in tabular form the preferred basic sizes of mating parts, the preferred tolerances and allowances, and a series of standard tolerances so arranged that for any one grade they represent approximately similar production difficulties throughout the range of sizes,

recommends five types: Running and Sliding Fits, Locational Clearance Fits, Transition Fits, Locational Interference Fits, and Force or Shrink Fits,

gives the standard types and classes of fits on a unilateral hole basis so that the fit produced by mating parts in any one class will produce approximately similar performance throughout the range of sizes,

prescribes the fit for any given size or type of fit; also the standard limits for the mating parts which will produce the fit,

contains an appendix giving the limits of size for holes and shafts for additional classes and grades of fits which special conditions may require.

Diameters up to 200 in. are covered with sizes in accordance with the British, Canadian, and American agreements (to 20 in.) shown in bold face type.

B4.1—1955 $1.50

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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

High Temperature Pump

Kobe, Inc., 3036 E. Slauson Ave., Huntington Park, Calif., announces its Triplex pump designed to meet the requirements of high-temperature, high-pressure testing of hydraulic components and systems used in aircraft.

It is currently in use on test installations operating at temperatures in excess of 500 F at pressures up to 5000 psi, the company reports.

The unit has closely-fitted metal-to-metal plungers and liners said to eliminate the need for seals. Plungers and liners come in a variety of sizes to provide varying pressures and volumes, and are interchangeable.

The forged steel fluid head is separated from the crankcase by a one-piece steel spacer block which serves to insulate heat from the crankcase. Even at exceedingly high temperatures over a long run, crankcase temperatures will not exceed 180 F, the firm states.

The pump is available either with stub shaft or integral electric motor. Power ratings are 60 hp. Displacement volume to 50 gpm. Pressure lubrication system is built in, plunger-liner leakage is returned to the system by a scavenging pump. The unit has integral double reduction gears, available in several ratios.

Hydraulic Power Packs

A new line of standard hydraulic power packs said to permit simultaneous operation of two, three or four fastener driving tools at full working pressure is available from Huck Mfg. Co., 2480 Bellevue Ave., Detroit 7, Mich.

Designated Series 800, the power packs are designed for use with the firm's line of standard hydraulic driving tools. The first power pack units are the Model 800 two-gun design and the Model 801, for use with as many as four guns.

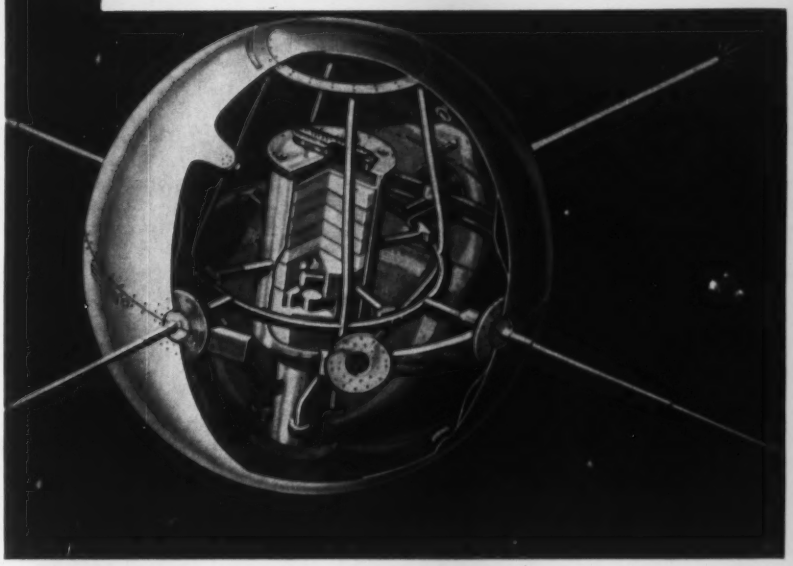
Although it is a stationary unit while in use, the new power pack is in effect a semi-portable central hydraulic system, the company states. It does not require permanent anchoring and is moved to a new location by means of a fork lift truck.

The packs are available equipped to accept either 220 or 440-v current. The electric drive motor is an induction constant-speed type rated at 10 hp for the Model 800 two-gun unit and at 15 hp for the Model 801 four-gun design. The high pressure hydraulic pumps are driven through a flexible coupling which provides shock overload protection. Model 800 is equipped with a $4^1/_2$ gpm pump; Model 801 has a double pump, each segment rated at $4^1/_2$ gpm for a total capacity of 9 gpm.

Oil is delivered to flow control valves that permit individual regulation of volume of oil delivered to each gun in the circuit.

The hydraulic system is cooled by an air-type heat exchanger. Cooler capacity is designed to maintain the reservoir oil temperature at 20 F above ambient.

ENGINEERS: *Electronic & Mechanical,* **PHYSICISTS**



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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Centrifugal Pumps

A new self-priming line of Motor-Mount centrifugal pumps is offered by Deming Co., Salem, Ohio.

The unit is designed for swimming pool and lawn sprinkling service, pit drainage, sump level control and general liquid handling.

The line includes Fig. No. 3351, ranging from 1/2 to 1 1/2 hp and Fig. 3350, available in 2, 3, and 5 hp sizes.

Gasketing Materials

Five new high density fiber gasketing materials said to make it possible to obtain seals at low flange pressures have been developed by the Industrial Div. Armstrong Cork Co., Lancaster, Pa.

The new materials include: AS-460 Asbestos Accopac—82 lb density, seals at 2000 psi, performs satisfactorily in flanges at 500 F, excellent torque retention, GRS synthetic rubber binder; AD-870 Asbestos Accopac—82 lb density, seals at 2000 psi, performs satisfactorily in flanges at 500 F, excellent torque retention, Neoprene rubber binder; AN-890 Asbestos Accopac—82 lb density, seals at flange pressures between 1500–2000 psi, performs satisfactorily at 500 F, excellent torque retention, nitrile rubber binder; CN-808 Accopac—60 lb density, seals at 800 psi, combination of cellulose fiber, cork and nitrile rubber makes it possible to maintain unusually close tolerances on gage, especially applicable in such industrial applications as carburetors and gas container instruments; N-840 Accopac—78 lb density, seals as low as 1500 psi, an impervious structure designed primarily for heavy duty service where compressibility must be at a minimum and bolt torque must be retained.

Miniature Clinch Nuts

Two new miniature self-locking clinch nuts with a shank design that permits flush installation in stock as thin as .030 in. have been developed by Elastic Stop Nut Corp. of America, Union, N. J.

The Type NCFM nuts are designed with special nylon locking inserts for temperatures up to 350 F, and Type LHCFM features an all metal nut with an elliptical crown locking device for use up to 550 F.

Reduced material thickness, smaller mounting area and lighter parts combine to reduce the overall unit weight, the company states. Both types require only two shank lengths for flush mounting installation in material ranging in thickness from .030 to .060 and .060 and above.

Thread sizes designed for both types of miniature clinch nuts are 2-56, 4-40, 6-32, 8-32, 10-24, 10-32, 1/4-20 and 1/4-28. The nuts are made of cadmium plated steel and meet applicable performance requirements of AN-N-5/AN-N-10 and/or MIL-N-25027 (ASG).

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Hydraulic Cylinders

A line of hydraulic cylinders to complement the miniature size of its hydraulic pumps is being produced by Oil-Dyne, Inc., 2117W W. Marquette Rd., Chicago 36, Ill.

These 3000 psi, noncushioned cylinders are being offered in five bore sizes at present: 1/2, 3/4, 1, 1 1/4, 1 1/2 in. All except the 1/2 in. size are available with standard or 2:1 rod. A line of cylinder mountings is also being produced.

Because of their exceptionally small size, the cylinders may be used for actuation on many smaller products and will conserve space when used on larger products, the company states. The cylinders have a new, long life, low coefficient of friction seal. Rated at 3000 psi continuous service, with peaks up to 10,000 psi, cylinders are available in lengths up to 36 in. stroke.

Pressure Relief Ventilator

Model PR low silhouette pressure relief ventilator introduced by Loren Cook Co., 227 Depot St., Berea, Ohio, is made in nine throat sizes from 6 to 27 1/2 in. diameter.

In some applications the unit can be used as an air intake, the firm reports. The new ventilator is constructed entirely of spun aluminum, except for the fasteners. An inverted cone in the cap guides the air flow to reduce turbulence. The ventilator is available with automatic louvers and motor-operated louvers.

Filter Cartridge

Hilliard Corp., West 4th St., Elmira, N. Y., announces a new high-flow rate low-pressure drop filter cartridge, type PL, for the filtration of oil, water and many other liquids.

The cartridge consists of a fine quality filter paper, impregnated with a heat stabilizing resin, which is pleated, and curved at the stabilizing temperature. This extended surface-type filter is then formed around a metal center tube, and the end plates and a protective shield are attached by a special process.

According to the firm, the cartridge is ideal for full flow filer applications and will filter out particle sizes down to 5μ with continuous recirculation resulting in even finer filtration.

FIGHT VIBRATION WITH VIBRATION

Now...shake-test to 5000 cps with 1750 lbs force!

HERE is an electrodynamic vibration exciter with highest operating frequency in its force range. The Model C10 VB exciter extends the range of vibration testing systems to 5000 cps with no table diaphragming or disturbing resonances under 5000 cps. Liquid cooled, it delivers up to 1750 lbs force output for continuous sinusoidal testing ... and extends the range of random motion testing to 5000 cps.

This exciter can be used with the MB Model T666 amplifier and TEMC control cabinet to subject specimens such as relays, electronic and control components through a wide range of vibratory frequencies to as high as 58 "g". Also, by the addition of the MB Model T88 complex motion console, it can be used for complex motion testing where specimens are subjected to the actual "noise" spectrum of the environment.

DESIGN ADVANCES

A UNIMODE rocker system (pat. pend.) restrains the 30 lb. moving table on its suspension. It assures linear motion over the total stroke of 1" (D.A.) – *continuous duty*. A packaged oil system and heat exchanger cool this equipment and permit its use in environmental chambers.

FOR OTHER NEEDS

Present MB exciter ratings range up to 25,000 pounds force. Remember, too, that MB has a field service organization, including a Western office, ready to help you. Send for Bulletin 420-C.

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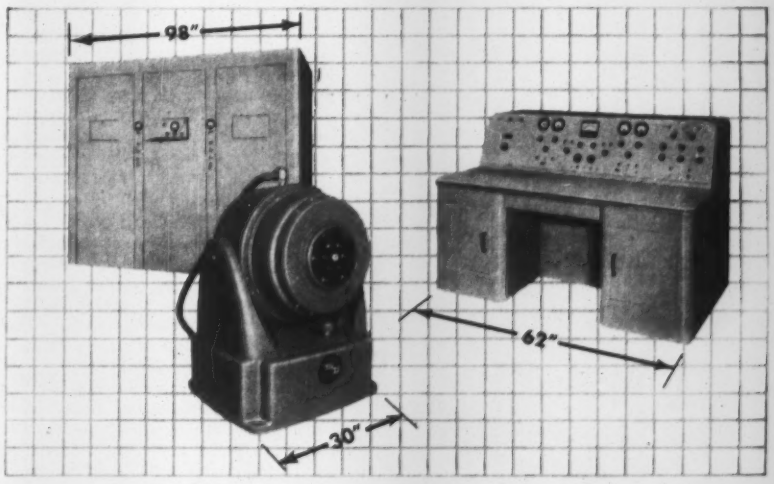

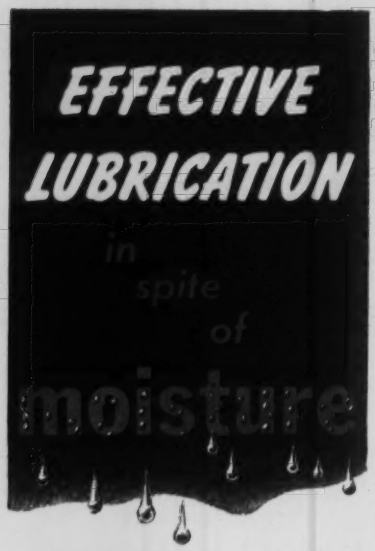

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affords machine parts and bearings real protection against rust and corrosion. It is a grease type lubricant that possesses the utmost in water and acid resistance. It has exceedingly high film strength. Due to the marked adhesiveness and water resistance of LUBRIPLATE 130-AA, it does not wash off readily, hence is the ideal lubricant in the presence of moisture.

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Plate Magnet

Tramp iron separating efficiency up to $2\frac{1}{2}$ times better than ordinary units is claimed for a new plate magnet developed by Stearns Magnetic Products, 635 S. 28th St., Milwaukee, Wis.

Designed to remove tramp iron from flowing material in chutes, spouts, ducts or on conveyors, the series plate magnet employs an exclusive offset air gap principle designed to take advantage of the magnetic strength of Hyflux Alnico V, said to be the most powerful permanent magnet material commercially available.

Deburring Machine

Introduction of a new universal two-station deburring and chamfering machine with integrated automation equipment is announced by Modern Industrial Engrg. Co., 14230 Birwood Ave., Detroit 38, Mich.

Designated Model BMED-14S, the machine functionally chamfers and deburrs gear teeth at both ends of a groove. Each part is automatically processed through two work positions in a cycle time of 6 sec at a rate of 600 parts an hour.

The new machine removes the sharp edges on the ends of gear teeth and simultaneously gets rid of the burrs resulting from the gear-cutting process, the firm states. Although the automation equipment is custom tailored, the basic universal machine will handle spur gears, helical and straight-sided as well as involute-form splines from $\frac{5}{8}$ to $6\frac{1}{2}$ in. PD. Production rates of up to 5 teeth per second per side can be assured.

The automation equipment also designed by Modern Industrial, works off only one ($3\frac{1}{4}$ in. bore, 6 in. stroke) air cylinder and four interlocked limit switches. For easy tool access, the automation is mounted on two guide bars—loosening two screws is all that is necessary to move it out of the way. Re-positioning is accomplished by sliding it back against positive stops.

At work, parts are fed from a distribution system to the "in" slide and chuted to a "foolproofer" stop where they are checked by mechanical fingers for proper horizontal position. If misaligned, the machine automatically shuts itself off (and flashes a red light as a visual signal) until manually cleared. Properly oriented parts continue through the chute, butting against a spring-loaded gate for retainment prior to entering the machining cycle.

One part enters the index fixture at a time —it is moved to a work station and positioned against spring-loaded bushings. As the dovetail-form cutters are stroked across the part face being chamfered, a pilot gear electrically counts the number of teeth. When completed, the counter stops the machine with the cutters in a retracted position. The part is then moved (with another part taking its place) to the second work station where the other face of the groove is chamfered by the same method. From here, the part is chute-ejected.

SAFETY CODES

Now Serving as Guides

to manufacturers, purchasers, and users of equipment and to state and municiple authorities having jurisdiction over the subjects within the scope of these documents.

CODE FOR PRESSURE PIPING
B31.1 — 1955 $3.50

Covers design, fabrication, materials, installation, and testing of the following systems and piping components: power piping, industrial gas and air piping, refinery and oil transportation piping, district heating piping, and refrigerating piping systems.

GAS TRANSMISSION AND DISTRIBUTION PIPING SYSTEMS
B31.1.8 — 1955 $2.50

Design, fabrication, installation, testing and the safety aspects of operation and maintenance of these facilities are covered.

CRANES, HOISTS, DERRICKS
B30.2 — 1943 (Reaffirmed 1952) $2.50

Presents rules for construction, installation, and maintenance of cranes and derricks driven by steam engines, electric motors, or internal combustion engines; for simple drum hoists; overhead electric, and overhead air-hoists; and handpowered derricks.

INDUSTRIAL POWER TRUCKS
B56.1 — 1955 $1.50

Applying to both the driver-ride and driver-lead types, this Code promotes safety to personnel and equipment by establishing uniform fundamentals of certain elements of design and by setting up rules for operation and maintenance of the trucks.

ELEVATORS, DUMBWAITERS, AND ESCALATORS
A17.1 — 1955 $3.50

Gives safety requirements relating to the design, construction, operation, installation, tests, maintenance, alterations, and repairs of hand and power passenger and freight elevators, hydraulic elevators, power and hand sidewalk elevators, private residence elevators and inclined lifts, dumbwaiters, and escalators.

NATIONAL PLUMBING CODE
A40.8 — 1955 $3.50

An up-to-date set of requirements applying to the design, installation, inspection, tests and maintenance of plumbing systems. Contains trailer coach and trailer park standards, and administrative data for law enforcement agencies.

MECHANICAL POWER TRANSMISSION APPARATUS
B15.1 — 1953 $2.00

Contains rules for safeguarding all revolving and reciprocating parts of equipment used in the transmission of power including connecting rods, cranks, flywheels, shafting, pulleys, belts, chains, ropes and drives, gears, clutches, counterweights, belts, keys, set screws, etc.

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Standard Flexible Shafts

A standardized line of flexible shafts, complete with couplings for immediate installation, for solving a variety of power transmission and control problems has been announced by S. S. White Industrial Div., 10 E. 40th St., New York 16, N. Y.

Available in six different models, the new standard shafts were developed primarily to provide quick delivery of small quantity shaft requirements for design, experimental and prototype work for designers and engineers, the company states.

Three of the new standard shafts are specifically designed for remote control applications, three for power drive. Each shaft in the standard line is stocked in three-foot lengths.

Electromechanical Counter

A new electromechanical counter said to have a life of 300 million counts, count rate up to 60 per second, either electrical reset or manual reset by a single-stroke push bar, has been announced by Autron Engineering, 1254 W. 6th St., Los Angeles 17, Calif.

The unit adds, subtracts, and totalizes. If add and subtract pulses are received simultaneously, a zero count results. It is not necessary to have any specific sequence of add or subtract impulses, nor will the counter jam from an incomplete pulse, the firm states.

The totalizer will operate best with a counting pulse ratio of 50 per cent on, 50 per cent off. While a square wave pattern for the pulse shapes is best, the totalizer will handle a wide variety of pulse shapes providing the leading edge of the wave is reasonably steep, the company points out.

Fractional HP Motors

Motor Div. Robbins & Myers, Inc., Springfield, Ohio, has introduced its new line of Model R re-rated fractional horsepower motors.

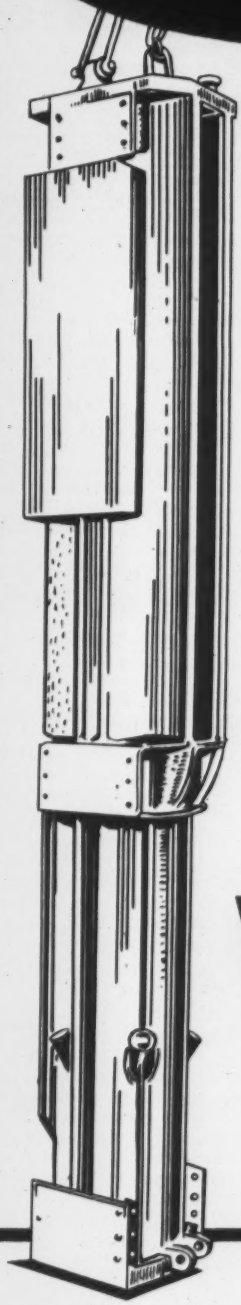
Designed in NEMA frames 56 and 48, they are available in ratings from 1/8 to 1 hp in polyphase, capacitor single phase, permanent split capacitor and (in the smaller ranges) split phase types.

Many of the redesigned ratings weigh less than half as much as the equivalent power in the older frames. For example, the new 3/4 hp, 1725 rpm, single phase motor weighs 26 lb compared to 56 lb in the old size. The new motors, however, are well within national standards for torque and overload service factor, the firm states.

A redesigned ventilating system had helped make it possible to put many ratings usually expected only in the 56 frame into the smaller 48 frame, the company says. Thus, such ratings as 1/3 and 1/2 hp, 1725 rpm, single phase motors are offered in either 56 or 48 frames. In special designs, especially at 3450 rpm, ratings of 1, 1 1/2, 2 and 3 hp are available.

PORUS-KROME Means ...

Longer Cylinder Life for McKiernan-Terry Diesel Pile Hammer



One million foot-pounds of energy per minute. That's what the McKiernan-Terry Pile Hammer delivers, averaging 18,000 foot-pounds per blow in striking up to 60 blows per minute. Such rugged service demands the ultimate in materials.

That's why Porus-Krome, the porous chromium, is "standard equipment" on the bore of this unique free piston engine. Porus-Krome prolongs cylinder life and contributes to reduced lube oil consumption—for economy of operation.

Write to Dept. F., Van der Horst Corp., Olean, N.Y. for your copy of "On POROUS-KROME", the twelve page illustrated brochure that tells the story of POROUS - KROME
Good for the Life of your Engines

● First in Electroplating - Research, Engineering, Production

VAN DER HORST

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McDonnell goes High Pressure

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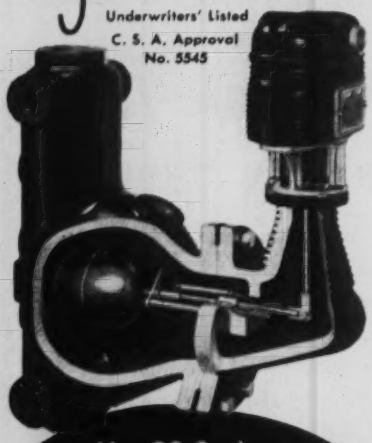

No. 92 Series
Pump Control, Cut-off
and Alarm Switch
For pressures to 250 psi.

- Repulsion magnetic switching—for positive opening *and* closing.
- Unprecedented heat dissipation—okayed for 75° C. (167° F.) wiring at terminals.
- Extra generous clearances in float chamber.
- Operating levels unaffected by pressure changes.
- McDonnell quality throughout.
- Four models—with or without integral water column.

Use this new 92 Series for controlling boiler feed pump, or electric valves; for low water cut-off or alarm; for tank level control, etc. For lower pressures—to 150 psi.—use companion 91 Series. New catalog has full engineering data.

Write for Bulletin L-123

McDONNELL & MILLER, Inc.
3510 N. Spaulding Ave. • Chicago 18, Ill.

Doing One Thing Well

McDONNELL
Boiler Water Level Control

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Viscous Fluids Measurement

Announcement of a differential pressure liquid level transmitter, Type 13 FA d/p cell transmitter, that mounts directly on a tank nozzle to measure viscous or slurry-type liquids in open or closed vessels, has been made by Foxboro Co., Foxboro, Mass. The unit operates on the force balance principle and maintains calibrated accuracy over a wide range of ambient conditions.

The level measuring element—a silicone-filled diaphragm capsule—is assembled in a 3-in. flange for flush mounting on the side of a vessel. Head of liquid in the vessel applies force to the high pressure side of the capsule which is opposed by force on the low pressure side. The low pressure side may be open to atmosphere for measurement of open tank level, or it may be connected by piping to the top of a closed tank to balance out static pressure. Adjustable range suppression and elevation springs can be attached to accommodate the various installation arrangements, the firm reports.

The pneumatic output of the transmitter—a 3-15 psi signal proportional to tank level—will operate a remote indicator, recorder or controller. An auxiliary signal amplifier is not needed. Purging systems are said to be eliminated since viscous liquids are measured at tank side and not conducted through tubing. Wetted parts are Type 316 stainless steel.

Manual Motor Starter

A manual motor starter, with a plug-in heater that can be inserted in a matter of seconds into the front of the unit, has been developed for use with such equipment as grinders, conveyors, hydraulic presses, blowers and mixers by General Electric Co., General Purpose Control Dept., Schenectady, 5, N. Y.

Designed for use with single-phase fractional horsepower motors up to one horsepower, the starter is smaller than the model it replaces, the company reports.

The plug-in heater is keyed so that it cannot be inserted the wrong way, and it can be installed without the use of screws. After the wire has been stripped, it is inserted in the pressure-type terminal receptacle and the screw is tightened a half turn from the front. Incoming leads at the top of the enclosure and outgoing leads at the bottom provide straight through wiring. Terminals are clearly identified.

Overload protection is provided by a bi-metallic thermal mechanism that automatically opens the contacts when an overload occurs, removing the motor from the line. The plug-in heater simulates the motor's temperature and causes a bi-metallic strip to bend. The strip is designed not to trip the mechanism on momentary overloads, such as starting currents, but will guard the motor against even small persistent overloads, according to the firm.

Pressure Transducer

Fischer & Porter Co., 93 Jacksonville Rd., Hatboro, Pa., announces a pressure transducer developed for use in data reduction systems.

The device converts a 3–15 psi signal to a-c mv directly proportional to the pneumatic input. When pressure is applied to the sensing element of the transducer, the resulting movement of an expandable capsule displaces an armature which induces opposing voltages in twin secondary coils. This voltage is linearly proportional to the pressure input.

The output may be used to position an indicator, recorder or control device. Accuracy of the pressure transducer is 0.25 per cent of the full scale, the company states.

Over-Riding Cranes

A newly designed line of over-riding cranes has been announced by Becker Crane and Conveyor Co., 4900 Ridge Rd., Cleveland 9, Ohio.

The new models are available in capacities from 1 to 10 tons and for spans up to 50 ft. Hand-pushed, hand-chain driven or motor-driven styles are supplied. They can be supplied as a completely assembled unit or, when necessary, as packaged components for assembly at the job site. Individual components include end trucks with bridge beam attachment fittings, motor drive parts, controls and electrification equipment. Drawings for on-the-job crane assembly are provided.

The end trucks consist of welded steel, box type structures, rigidly diaphragmed. Designs for either single or double bridge construction are available.

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A good book to consult for authorized definitions of approximately 500 occupational specialties in engineering.

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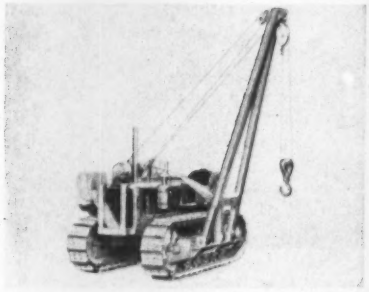
BUSINESS NOTES
LATEST CATALOGS



Hydraulic Pipelayer

Now available from Caterpillar Tractor Co., Peoria, Ill., is a new D4 tractor arrangement, incorporating a newly-announced No. 4 hydraulic pipelayer, designed for use on smaller diameter pipelines. The pipelayer is manufactured by Midwestern Mfg. Co., Tulsa, Okla.

The pipelayer has a rated lifting capacity of 17,500 lb at 4-ft overhang, and has a boom length of 13 ft. When attached, it provides a tractor clearance of 13½ in. Hydraulically operated counterweights are furnished as standard equipment.

The pipelayer is said to be especially suited for use by municipalities, public utilities, oil companies, and contractors specializing in small pipe. It can also be used for handling such miscellaneous items as concrete drain pipe, and can serve as a mobile crane with relatively large capacity, the company states.

According to the company, simplified operation, precise positioning and maneuvering of heavy loads is made possible by a closed hydraulic system controlling the sideboom. Throttling type hydraulic valves are designed to assure positive and rapid response of the sideboom, even under capacity loads. The unit can backfill when it is equipped with an angle filler, which is also available from Midwestern, and which operates from the same hydraulic system as the pipelayer.

Oxy-Acetylene Welding

An improved model of its Prest-O-Lite No. 420 welding and cutting outfit capable of welding up to ⅜ in. and cutting up to 2 in. has been introduced by Linde Co., Div. Union Carbide Corp., 30 E. 42nd St., New York 17, N. Y.

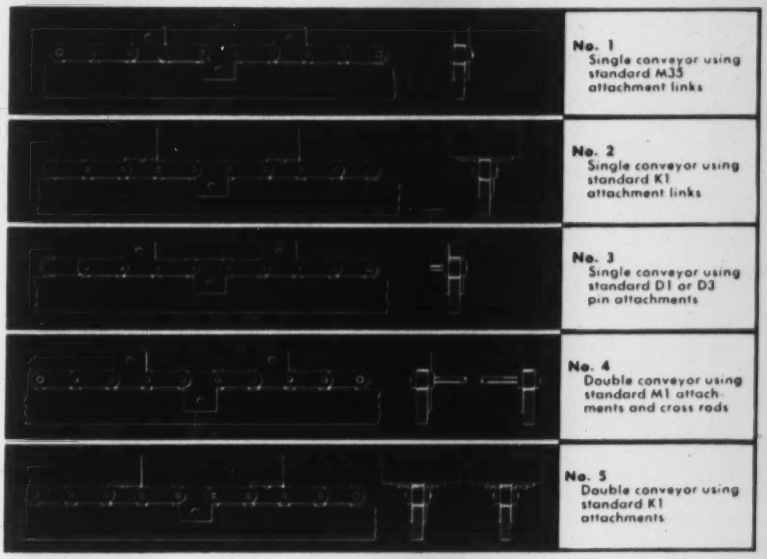
The cutting oxygen lever has been moved to the top of the handle where it can be turned on or off with the thumb. A green plastic ring has been placed around the oxygen valve and a red ring around the acetylene valve for identification.

Plastic gage crystals for oxygen and acetylene regulators, furnished with the outfit, have been replaced by nonclouding glass kept in place with a screwtype retaining ring.

The new model includes four interchangeable tips (3 welding, 1 cutting), 12 ½-ft length twin hose goggles, friction lighter, wrench, and instructions.

automation

YOU CAN CUT COSTS BY MOVING YOUR MATERIAL WITH ACME DOUBLE PITCH CONVEYOR CHAINS


No. 1
Single conveyor using standard M35 attachment links
No. 2
Single conveyor using standard K1 attachment links
No. 3
Single conveyor using standard D1 or D3 pin attachments
No. 4
Double conveyor using standard M1 attachments and cross rods
No. 5
Double conveyor using standard K1 attachments

DOUBLE PITCH ROLLER CHAINS

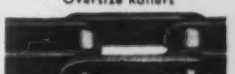
Double pitch conveyor chains, sometimes known as extended pitch chains are becoming increasingly more popular in many industries where high grade finished roller chains are required, at a lower cost than the standard pitch chains. This series was developed on the basis of using standard round parts of the standard series and doubling the pitch. For example double pitch chain #C-2080 which is 2" pitch utilizes the same round parts as 1" pitch heavy series chain #80H.

In addition to being applicable for slower speed power transmission drives these chains are widely used as conveyors for the handling of materials. A standard line of attachments are available that gives this line great versatility in reference to incorporation of cross flights, cross rods, etc., that are applicable for conveyor work.

The double pitch series of chains are widely used in the Agriculture Implement, Baking Machinery, Construction Machinery, Mining, Packaging, Textile industries, etc.

Figure 8 Side Plates, Standard Rollers

Figure 8 Side Plates, Oversize Rollers


Straight Side Plates, Standard Rollers

Straight Side Plates, Oversize Rollers

SPROCKETS

Sprockets for Double Pitch Chains can be furnished in either SINGLE TOOTH FORM OR DOUBLE TOOTH FORM, as shown on the right.

Double tooth cutting actually doubles the life expectancy of the sprocket.

Chain rollers contact only every other tooth. When these teeth become worn after long service, the sprockets can be advanced one tooth, thus permitting chain engagement on a new series of sprocket teeth.

Double pitch chains can be furnished in either Figure 8 or straight side plate type. with standard or oversize rollers.

Single Tooth Cutting — Double Duty Tooth Cutting

FREE CATALOG

Write Dept. 11-L for new illustrated 76 page catalog on use and application of roller chains and sprockets.

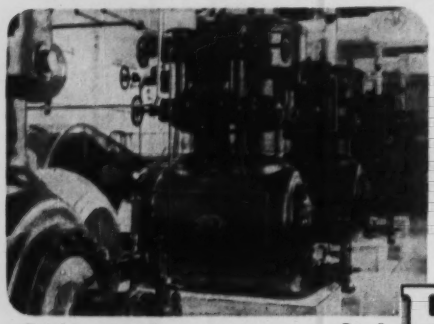
Acme Chain Corporation
HOLYOKE MASSACHUSETTS

Call ACME for Service

GOODYEAR'S NEW CHEMIGUM PLANT EQUIPPED WITH FRICK REFRIGERATION

This versatile plant, just completed at Akron, makes many types of rubber, latices and plastics. The big reactors, each holding 3000 gallons, are lined with glass; each is cooled with seven banks of glass-coated ammonia coils of the patented Frick direct-expansion design.

These coils, with their control system, enjoy a world-wide preference for use in chemical reactors.



Four Frick compressors of 12 in. bore and 12 in. stroke, together with a 5 by 5 machine, carry the refrigerating load under automatic and semi-automatic controls.

When you want the most durable and efficient refrigerating equipment, whether for air conditioning, process work, ice making, quick freezing or other cooling service, specify "Frick". Literature and estimates on request.

Frick ammonia compressors at Goodyear's new plant in Akron, Ohio.

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA., U. S. A.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

All-Angle Screw Driver

Albertson & Co., Inc., Sioux City, Iowa, has announced a new portable electric all-angle screw driver, designed to drive or remove wood screws, self-tapping screws, lag screws, and machine screws and nuts.

It is offered with a positive or adjustable clutch. The positive clutch provides a free spindle for engaging bit with screw, and operating pressure closes the clutch and continues to drive until the resistance is greater than the hand pressure.

The adjustable clutch operates the same as the positive clutch, except that driving force is predetermined by adjusting the spring load for the desired tightness.

Phillips, Frearson, slotted, clutch head, socket head and Robertson screw driving bits are available.

Potentiometer

What is described as a new design concept in multi-turn precision potentiometer construction has been announced by Components Div., Fairchild Controls Corp., 225 Park Ave., Hicksville, N. Y.

The type 909 model, a $^{7}/_{8}$-in. diam multi-turn is the first in the series.

Instead of the conventional slip ring, the new design utilizes a helical slip bar, which serves also as a guide for the wiper, the company reports. The wiper assembly straddles the slip bar and the wiper rides on the resistance winding in the middle. The firm says this provides a dual slip bar contact, and results in superior vibration characteristics. By riding the helical bar, and thus eliminating wear on the resistance element, life characteristics have been greatly improved, it is claimed.

Metal to glass type terminals are welded to the case instead of the conventional type terminal board. It can be tapped at frequent intervals and designed with shorter sections or wide ranges of over travel.

Mechanical rotation of 3 to 20-turns per cup is available in either sleeve or ball bearings and in bushing or servo type mounting plates.

Typical resistance range is 100 ohms to 200,000 ohms for a 10-turn version of the type 909. Standard linearity is 0.5 per cent with 0.05 per cent available on special order.

Rated at 2.5 w at 40 C the standard 909 derates to 0 at 90 C and the high temperature version derates at 150 C.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Balancing Machine

A new belt-over-the-part static-dynamic balancing machine for parts of up to 100 lb has been announced by Tinius Olsen Testing Machine Co., 6057 Easton Rd., Willow Grove, Pa.

Principal new features of the machine include a high speed belt drive which rotates the part within the balancing machine bearings. Both the angle and amount of unbalance are shown on two electrical meters mounted in the control cabinet.

A switch in the control cabinet permits the operator to change the plane of correction instantly, the firm states. Positive plane separation is said to be assured by the pivoted, vibrating cradle design used.

Time Switch Control

A new socket-mounted time switch control for auto-switch capacitor equipments has been introduced by General Electric Co., Hudson Falls, N. Y.

The device, designed to control FKC or VR oil switches and vacuum switches used with pole-top and substation capacitor equipments, includes a sealable opening for time-setting purposes, and a push-pull omitting device to omit switching on designated days of the week.

Two sets of trippers provide two on-off operations per day, and are standard equipment with the new unit. Extra trippers and a control for operating at 240 v can be furnished.

The timing and driving mechanism of the new control is a high torque motor with permanent lubrication. The contact assembly of the unit is rated 35 amp, a-c, and features quick-make and quick-break action. All control switch connections are brazed.

Solenoid Pilot Valve

A new silver model valve, designed to comply with JIC standards, has been introduced by Ross Operating Valve Co., 120 E. Golden Gate Ave., Detroit 3, Mich.

Tests indicate the new spool solenoid pilot valve has a life of 25,000,000 cycles, the firm reports. The valve bodies, providing modular construction for flexibility in applications, include straight way, normally open and normally closed; three way open and closed; all in the in-line series; and three way, normally open and normally closed; and four way; all in the base-mounted series.

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Give...the United way

Firing area experiments at Yucca Flat, Nevada Test Site, using anchored balloon as detonation platform for full scale nuclear tests. (USAEC photograph)

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1956 MANUAL OF CONSULTING PRACTICE FOR MECHANICAL ENGINEERS

A Guide for Consulting Engineers and Their Clients

It sets forth the proper approach in obtaining professional engineering services, in establishing the fundamental structure in engineering agreements, and in setting up conditions applicable to the conduct of engineering assignments under various types of agreements.

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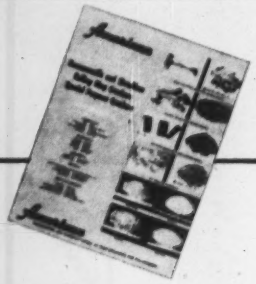

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RING CRUSHERS • SHREDDERS
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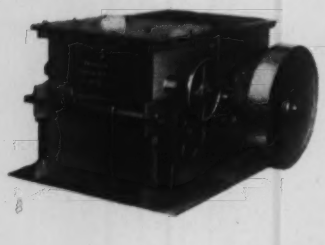

Ammonium Nitrate	Fluorspar
Carbide	Gypsum
Cryolite	Salt Cake
Clay	Soda Ash
Coal	Sodium Sulphate
Bauxite	Sulphur

and many, many others

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2-cylinder models 10 to 18 hp.

4-cycle single cyl. models, 3 to 9 hp.

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Torque Champs

WISCONSIN ENGINES

3 to 56 h. p.

Wisconsin basic HIGH TORQUE design pays off in terms of "Most hp. Hours" of on-the-job heavy-duty service, at all temperatures from low sub-zero to 140° F. Team-up your equipment with Wisconsin HIGH TORQUE Champs—backed by over 2,000 Wisconsin Authorized Service Stations, world-wide. Write for full-line "Spec" Bulletin S-212.

V-type 4-cylinder models, to 56 hp.

New Model VR4D 43 to 56 hp.

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World's Largest Builders of Heavy-Duty Air-Cooled Engines

MILWAUKEE 46, WISCONSIN

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Blind Rivets

A new oversize-diameter design has been added to the line of conical Keystone Lock blind rivets produced by Huck Mfg. Co., 2480 Bellevue Ave., Detroit 7, Mich.

The firm says the new rivets are made $^{1}/_{64}$-in. oversize on diameter to insure hole filling and produce a good tight installation in dimpled sheets. They are available with countersunk head style in a wide variety of sizes.

Where comparatively thin sheets are dimpled for countersunk rivet installation, the holes will be enlarged slightly in the dimpling process. Pin material for the new fasteners is 7075-T6 aluminum alloy, per Specification QQ-A-282. Pins are anodized, per Specification AN-QQ-A696 or given chemical surface treatment, per Specification MIL-C-5541. Sleeve material is 5056-H14 aluminum alloy, per Specification AN-QQ-W-298.

The rivets are available in $^{1}/_{8}$-in., $^{5}/_{32}$-in. and $^{3}/_{16}$-in. oversize sleeve diameters. Each diameter is available in a range of part numbers to meet a variety of fastening specifications.

Rolling Mills

Development of a range of heavy duty, high precision 2-high/4-high combination rolling mills for use in both ferrous and non-ferrous metals laboratories and pilot plants has been announced by Loma Machine Mfg. Co., Inc., 114 E. 32nd St., New York 16, N. Y.

Designed to take the heavy pass reductions and to maintain the close thickness tolerances required in the processing of such materials as high temperature super-alloys, nuclear fuels, stainless steels and refractory metals, the mills have exceptionally high separating force and torque transmission capacities.

They are currently available in backup roll diameters from 6 to 15 in., in work roll diameters from $^{3}/_{4}$ to 5 in., and in face widths up to 24 in.

A representative 5 in. and 15 in. × 10 in. reversing mill is used in a 15 in. × 10 in. 2-high setup for either hot or cold breakdown rolling of slabs; in a 5 in. and 15 in. × 10 in. 4-high setup for either hot or cold intermediate rolling of strip; and in a $2^{1}/_{2}$ in. and 15 in. × 10 in. 4-high setup for the cold finish rolling of strip to very thin gages and close tolerances. The outboard housing of the mill can be moved to increase the face width from 10 to 20 in., so that 15 in. × 20 in. grooved rolls can be used in a 2-high setup for the hot or cold rolling of rounds, squares and other shapes.

Depending upon size and application, the mills are furnished with needle roller or oil film sleeve bearings on the journals, with manual or twin-motor screwdown and with either constant-speed a-c or variable-speed d-c drives.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Electronic Speedometer

Streeter-Amet Co., Grayslake, Ill. announces a new Ametron electronic speedometer designed to determine and register the speed of vehicles.

The unit is a portable tube operated instrument that can be handled by one man checking in both directions, the company states. The distance between the two road tubes is 11 ft. This is designed to enable the placing of the tubes in strategic spots to clock cars before the driver is aware of the check point.

It can be operated from a car by simply plugging into the cigar lighter.

Aluminum End Mills

End mills designed for aluminum and other nonferrous materials are now available in standard sizes from Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

Called the Fastlead series, the tools are high speed end mills that include regular and long length mills in diameters of $\frac{1}{4}$ to 2 in. Extra long length mills are standard in diameter of $\frac{1}{4}$ to $1\frac{1}{2}$ in.

According to the manufacturer, the series performs particularly well in aircraft forging tracer milling and in slabbing, cavity and deep pocket milling in both soft, nonferrous materials and the harder alloys. A new flute design and a high helix angle are said to insure positive chip removal while a new type relief is claimed to afford stronger, more durable cutting edges.

Cam Indexed Roll Feeds

Ferguson Machine Corp. of Indiana, Box 5841, St. Louis 21, Mo., has introduced a line of standard high speed roll feeds indexed with a roller gear drive designed to provide repetitive accuracy at rates up to 1000 strokes a minute.

The cam indexing method features positive feeding action without frictional braking. Rolls are connected by helical gearing so that little or no slippage is encountered at production speeds, the company states.

The drive consists of a precision cut, hardened and ground tool steel cam with a tapered rib and a hub with ball or roller bearing followers. As the cam rotates a curvature in the rib causes the hub to move one increment, resulting in a partial revolution of the rolls to feed the stock into the die. During the working or dwell time the followers are engaged and locked with zero backlash by a straight portion of the cam rib. According to the form the mechanism utilizes a modified trapezoid acceleration characteristic, to make starting and stopping action extremely smooth.

The indexing mechanism maintains an accuracy of .002 in. or greater, feeding some kinds of material at operating speeds as high as 500 strokes a minute without auxiliary locating methods.

HOW CHACE THERMOSTATIC BIMETAL ACTUATES THE

The Therm-O-Disc Type E Series Thermostat is designed for compact installations in clothes dryers, room and unit heaters, central heating furnaces, air conditioning and ventilating equipment, aircraft and miscellaneous devices, for controlling temperatures up to 350°. Both the EA and EC Series are for single pole, single throw operations and can be supplied with normally closed or normally open contacts. The EA (shown) is best suited for controlling temperatures in air streams; the EC is intended for surface mounting. Both types are actuated by an exposed disc of Chace Thermostatic Bimetal, altho EA is also available with enclosed disc for protection against dust, lint, moisture, etc.

Here's how Therm-O-Disc works; The pre-calibrated disc of Chace Thermostatic Bimetal snaps from a normally concave to convex form at the pre-set point of temperature rise, in the manner of an "oil can". The impact of this positive snap action against a bumper causes instantaneous make or break of the contacts or circuit. Upon cooling, the disc snaps into the original concave form, resetting the contacts.

Remember Chace when you design for temperature actuation or indication, or for protection of valuable equipment. Dependable Chace Thermostatic Bimetal is available in 28 types, in strip, coil or completely fabricated and assembled elements made to your specification. Write for new 44-page booklet, "Successful Applications of Chace Thermostatic Bimetal", containing interesting uses of bimetal and many pages of engineering data.

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W. M. CHACE CO.
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1619 BEARD AVE., DETROIT 9, MICH.

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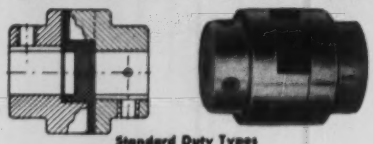
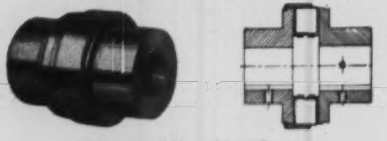
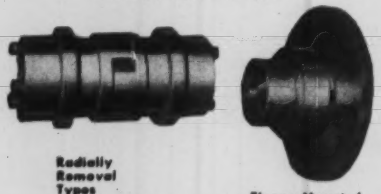
Maintenance-Free
FLEXIBLE
COUPLINGS



Standard Duty Types
.05 to 40 hp. at 1750 rpm.



Medium and Heavy Duty Types
2.6 to 810 hp. at 100 rpm.



Radially Removal Types
1.9 to 30 hp. at 100 rpm.—2 to 40 hp. at 1800 rpm.

Flange-Mounted Types
11 to 740 hp. at 900 rpm.

Put Trouble-Free Performance Into Your Equipment

COMPARE THESE FEATURES:

- A type and size perfectly suited to your application.
- Year-after-year dependability, regardless of load or operating conditions.
- Completely machined for ease and speed of alignment.
- No lubrication required.
- Simple, rugged construction—few parts and no intricate mechanisms.
- Cushioned power transmission—load is transmitted through cushioning materials—no wear on the metal jaws.
- Double-life cushions—one half the cushions act as idlers, except on reversing loads—quick interchange provides a new set of cushions.
- Cushions are engineered to the load and service conditions.

Ask Lovejoy to recommend the exact flexible coupling for your application. No obligation. Request catalog.

LOVEJOY FLEXIBLE COUPLING CO.

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KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Automatic Air Filter

Emco Pneumatic Corp., 1317 Locust St., Des Moines, Iowa, announces a fully automatic 1/2 in. air filter.

According to the company, the filter, named Emco Jet, automatically eliminates moisture, sludge and other foreign substances heavier than air from entering air operated devices. It operates on a maximum of 90 cfm. Maximum working pressure is 300 lb. Internal parts have been irridited to pass a 100 hr salt spray test, the firm reports.

The new unit has been designed to filter air for pneumatic equipment operating on intermittent air flow.

Carbide End Mills

A new series of helical carbide tipped end mills is available from stock from Goddard & Goddard Co., 12280 Burt Rd., Detroit 23, Mich.

According to the company, they have helical carbide cutting edges formed by a special process that produces a true helix with a constant positive rake for the entire length of the tooth face. These features are designed to permit higher feeds and speeds when milling cast iron and light metal alloys, for which the new tools were primarily designed. They can be used also for light cuts in milling of steels under good conditions of rigidity, feed and speed, the firm reports.

The combination of positive rake and true helix provides rapid chip disposal and freer cutting action, the company states. Cutters have straight shanks flatted for set screws. Carbide tips are brazed to special high-tensile steel cutter bodies. Standard stocked diameters of the end mills range from 3/8 to 2 in. Special sizes and designs are also available.

Power Supplies

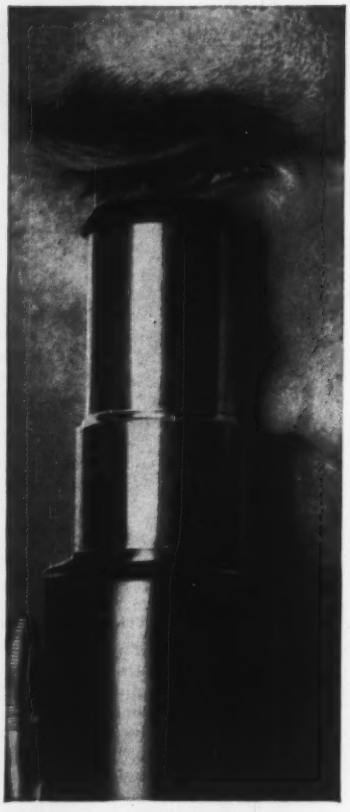
Small, transistorized power supplies for filament, transistor, and plate voltage applications are now available from UAC Electronics, Div., Universal Transistor Products Corp., 143 E. 49th St., New York 17.

The units are designed for use in computers, guided missiles, telemetering and aircraft electronic equipment and are said, by the company, to be as small and low cost as transformers alone.

Standard units are transistor regulated within 5 per cent and regulation is available in custom units to 0.1 per cent. Conversion efficiency for unregulated units is as high as 98 per cent, the firm says, and temperature stability from −55 to 125 C can be achieved.

Units can be supplied to meet MIL Specs. Outputs to 28 vdc at 15 amp or 2500 vdc at 300 ma are available in standard units from 115 vac, 60 cps, single phase; from 115 vac, 400 cps, single phase; or from 115 vac 400 cps, three phase inputs.

Units are as small as one cubic inch per watt and as light-weight as one ounce per watt, the company states.



This man is looking into your future

How does it look? Rosy? Free of cancer? You hope! But hoping isn't enough. Of every 6 Americans who get cancer this year, 3 will die because science still has no cure. It will take research . . . *lots* of research . . . to find that cure. And research, let's face it, takes money.

Instead of just standing by with hope, pitch in and help. Send your dollars . . . whatever you can afford . . . to the American Cancer Society today. You'll be bringing yourself and everyone else that much closer to a sure future. Send your check to "Cancer" in care of your local Post Office.

American Cancer Society

ENGINEERS

Mechanical, Electromechanical

Information manual about APL and its programs now available

The Applied Physics Laboratory (APL) of The Johns Hopkins University is unique in that we are neither an industrial nor an academic organization, but rather a composite, having drawn freely from the methodologies of each.

For thirteen years APL has pioneered in guided missiles. Today we are engaged in a broad program of R & D for the Navy; in addition, we are responsible for technical direction of industrial and academic contractors in developing the Terrier, Talos and other major weapons and weapons systems. Our staff members enjoy not only the stimulus of association with their immediate colleagues at APL, but also with those in other organizations of considerable stature.

NEW 30-PAGE PUBLICATION

A few positions for senior engineers and scientists are now open. Information on our accomplishments and goals is available in a new 30-page publication, just off the press.

In it staff leaders representing each of the various disciplines and fields outline the nature of their programs. Information on our new laboratory in Howard County, Md. (equidistant between Baltimore and Washington) is also included, together with facts on the outstanding communities in which our staff members live.

Quantity is somewhat limited. May we suggest you send now to: Professional Staff Appointments,

The Johns Hopkins University
Applied Physics Laboratory

8607 Georgia Avenue, Silver Spring, Md.

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Valve-Regulator

A pneumatically controlled, cylinder-operated lubricated plug valve regulator, designed to provide high-pressure gas regulation with minimum pressure loss, has been developed by Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.

Advantages of the new unit, according to the firm, include operational ease and favorable flow characteristics of the lubricated plug valve, high capacity with low pressure loss, silent regulation and automatic pressure control.

While the valve-regulator is effective on services such as intermediate pressure control, back pressure relief, and widely varying flows, it is primarily designed for high-pressure, large-volume applications. Typical installations include high-pressure transmission lines, storage and town border stations, the company reports.

The new regulating device consists primarily of a cylinder-operated valve with a pneumatic pressure controller and valve positioner. An increase or decrease of the downstream pressure causes a change in the output of the pressure controller, which, in turn, causes the valve positioner to apply pneumatic power to the cylinder operator, thus repositioning the valve and controlling the downstream pressure at the set point.

Electrolytic Hygrometer

Process Instruments Div., Beckman Instruments, Inc., 2500 Fullerton Rd., Fullerton, Calif., announces a new explosion-proof electrolytic hygrometer for industrial instrumentation in controlling corrosion, product purity and process efficiency.

Analysis is performed by utilizing the principle of electrolizing all moisture in a gas stream by a special element. According to the firm, the current required for this electrolysis indicates the precise amount of moisture present in the stream.

The unit automatically and continuously measures moisture concentrations in vapor samples with 5 per cent accuracy in a 0–1000 ppm range at temperatures up to 100 C, the company reports. Incorporated in the hygrometer is a contact meter and relay for attaching an alarm system that can be set for any point in the instrument's range. A standard potentiometric recorder or recorder-controller 10 or 50 mv can be operated from the water vapor in a plant process stream.

The sensing element is thermostated and is encased in an explosion-proofed housing that will meet requirements for Class I, Group D, Division I specifications.

The indicating section is in a gasket enclosed case for air purging. The indicating meter has a high limit contact, and terminals are provided for recording instruments. The unit is available with a copper and brass flow system (Model No. 18401), and for corrosive gases it is available with a 316 stainless steel flow system (Model No. 18402).

asg
UNIVERSAL JOINTS

available in 13 sizes with bored or solid hubs

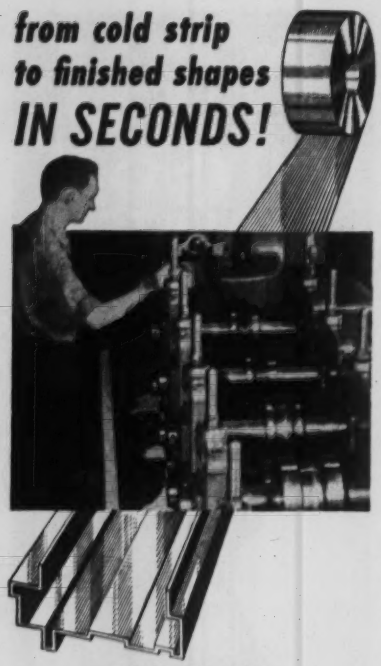
You can get ASG Universal Joints directly from stock in 13 sizes with bored or solid hubs ranging in diameter from .375" to 4.000". Special bores, bores with keyways or setscrews are available upon special order.

ASG Universal Joints are ruggedly constructed of heat treated alloy steel. Matching or mating parts are precision ground to permit easy interchangeability of components. Joints of ⅞" length and longer have snap ball oilers. Smaller Joints have oil holes. Oil enters at center of rotation to assure thorough lubrication of moving parts.

Send today for Bulletin No. 257 describing the full line of A.S.G. Universal Joints available from your nearest distributor.

AMERICAN STOCK GEAR DIVISION
PERFECTION GEAR COMPANY
HARVEY, ILL., U.S.A.

from cold strip to finished shapes IN SECONDS!



YODER ROLL-FORMING MACHINES

If you are in the business of manufacturing a product that is, or could be, made wholly or partly from flat rolled metals in thicknesses up to ½", a Yoder Roll-Forming machine can help reduce your production costs.

Cold-formed shapes of every description —including structurals, tubular products, moldings, trim, roofing and siding, panels, cabinet shells, etc., can be produced on Yoder cold-roll forming equipment at the rate of 25,000 to 50,000 feet per day at a conversion cost of only a fraction of a penny per foot! With speeds and costs such as this, even part-time operation of a Yoder roll-forming line is a profitable investment!

Additional operations such as welding, coiling, ring forming, perforating, notching, embossing or cutting to length can be simultaneously introduced to the basic shape at little or no additional labor cost. Yoder engineers are at your service in explaining the advantages of roll-forming for your individual needs.

A new, revised, Fifth Edition of the Yoder Cold-Roll Forming book is just off the press. In addition to economic and mechanical possibilities of cold-roll forming, it contains numerous illustrations of end uses and applications of roll-formed shapes. Write for your copy today.

THE YODER COMPANY
5499 Walworth Ave. • Cleveland 2, Ohio

YODER COLD ROLL FORMING MACHINES

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Radioactivity Measurement

A manual range changing linear count rate-meter, for use where precise measurement of radioactivity is required, has been introduced by Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.

The instrument, Model CRM-11, is designed to power and to detect radio-activity sensed by GM, scintillation and proportional counting detectors.

It is equipped with six linear scales, covering counting ranges from 0–300 C/M to 0–300,000 C/M.

The high voltage power supply regulates over a broad range of line voltage variations, using the magnetic resonance principle. The circuitry is conservatively designed for a minimum of 20,000 hours' operation. All tubes operate below 170 F.

Other features include a 3600 C/M test signal and connectors for operating either a 0-1ma graphic recorder or a 0-1mv electronic recorder.

Ultrasonic Transducer

A new ultrasonic transducer, Model UT-2-42, for ultrasonic cleaning, degreasing, and processing is announced by Vibro-Ceramics Div., Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J.

Using piezoelectric ceramics, the ultrasonic transducer is designed for modular assembly to cover large areas with nonfocusing and uniform sound field. It has a high conversion efficiency and a frequency for many types of processing, the company states.

It is hermetically sealed in stainless steel housing and is completely immersible in organic solvents, aqueous solutions of normal detergents, mild alkalis or acids.

Air Filter

Announcement of a new Far-Air type F/S air filter has been announced by Farr Co., 400 N. Silver Lake Blvd., Los Angeles 26, Calif.

The new unit is permanent-type, impingement filter with a cleanable, metal screen media. According to the manufacturer, it is designed to efficiently deliver 350 to 520 fpm air flow and is especially effective in areas where there is a high lint concentration in the air.

The filter media, which consists of flat and corrugated rows of wire screen mesh, will not gap or separate, the company states. It also permits a considerable amount of face-loading without impeding air flow, it is claimed.

Cleaning can be accomplished by directing a stream of water on the filter, then dipping or spraying with an adhesive.

The unit is designed in standard sizes for use in ordinary filter banks. Clips attached to the holding frames make installation simple. The filters are also suitable for economical installation in unit ventilators, packaged air conditioners, house lot air furnaces and cooling units, it is reported.

Engine Start-Stops

The availability of automatic start-stop systems for four more models of diesel engines has been announced by Caterpillar Tractor Co., Peoria, Ill.

The new systems, available as attachments, are designed for use on the firm's D326 (Series F), D337 (Series F), D375 (Series D) and D397 (Series D) diesel engines. Finding principal application on electric set installations, the systems instantaneously crank the diesel engine when utility power fails, the company reports. When the generator comes up to 90 per cent of rated voltage, an automatic transfer switch changes the load from utility source to the electric set. The transfer switch reverses the load to the utility line and shuts down the electric set when utility power is restored.

Vapor Condensers

Niagara Blower Co., 405 Lexington Ave., New York 17, announces new models of its Aero vapor condensers for replacing barometric type condensers to conserve water and provide high vacuum for evaporators in chemical process and food industries.

The new models increase the capacities available in Btu hourly ratings up to 15 million Btu per unit.

According to the company, the steam of vapor is condensed in tubes over which water is sprayed, removing the heat by evaporation in a stream of air, conducting the heat outdoors. Air, or noncondensible gas that is mixed with the vapor or steam to be condensed, is removed by means of a steam ejector nozzle or a vacuum pump, and is separated from the condensate by a specially designed and patented screening baffle-tube in the condensate drain. Condensing temperatures are within 20 F of the atmospheric wet-bulb temperature.

Pulse Generator

A new wide range pulse generator, Type 1050, operating in the range from 1.6 to 10.4 mc has been developed by Electronic Instruments Div. Burroughs Corp., 1209 Vine St., Philadelphia 7, Pa.

The unit was primarily designed for applications involving switching circuits which function in the ten megacycle range but it may be used in any application where pulses with high repetition rates are required, the company says.

The Type 1050 produces half sine wave voltage pulses continuously variable over its operating range in four overlapping frequency bands. The generator is equipped with amplitude and pulse duration controls and an output pulse polarity switch. The output amplitude is adjustable from 1 to 30 v and the pulse duration may be selected from one of five different widths ranging from 30 to 70 millimicroseconds.

It is mounted with its own power supply in an individual cabinet or can be mounted in a standard 19-in. relay panel rack.

Continued on Page 65

Need more engineering information on products advertised in this issue?

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If you would like further engineering information on any of the products advertised in this issue, circle the page numbers of these ads on one of the cards below . . . fill in your name and address and mail to us.
Your requests will be forwarded to the advertiser. The information will come directly to you.

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29 West 39th Street
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IFC	14	26	37	50	59	71	82	99	113	123	129
1	15	27	39	51	60L	72T	83	100–01	114	124TL	130
2	16	28	40	52L	61R	73	85	103	115	124TR	147
3	17–18	29	42	53	62	74	87	104	116	125	149
4–5	19	30	43	54L	65	75	89	105	117	126L	151
6–7	20–21	31	45	55	66L	76L	90	107	118	126TR	IBC
8–9	22	32	46L	56T	67T	76R	91	109	119	126BR	OBC
10–11	23	33	46BR	57TR	68L	77	93	110	120	127	
12	24	34	47	58T	69	79	95	111	121	128L	
13	25	35	48L	58B	70L	80–81	97	112	122	128TR	

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4–5	19	30	43	54L	65	75	89	105	117	126L	151
6–7	20–21	31	45	55	66L	76L	90	107	118	126TR	IBC
8–9	22	32	46L	56T	67T	76R	91	109	119	126BR	OBC
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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Remote Humidity Indicator

A remote humidity indicator, designed for measuring humidity of closed areas is available from Serdex, Inc., 91 Cambridge St., Boston 14, Mass.

According to the company, the indicator can be located in office, laboratory, or control room away from the area to be measured. An air line is run into the area to be sampled. A vacuum pump or line draws sampled air through the indicator.

Only two connections are necessary: from the inlet at the bottom of the indicator case to the air line from the container or area sampled, and from an outlet at the top of the case to a vacuum pump or line. No wiring is needed, since operation is mechanical, the firm reports.

For production use, the indicator can be installed permanently to give continuous humidity readings, the company says. Readings to a guaranteed accuracy of $\pm 1^1/_2$ per cent are obtained directly from the dial. To keep the temperature in the indicator chamber at the same level as the sampled area, a temperature-compensating coil is built into the indicator; when necessary, liquid of controlled temperature can be circulated through the chamber to maintain the instrument's temperature at the same level as the sample-area chamber temperature. A thermometer is visible through the indicator window.

Magnetic Cores

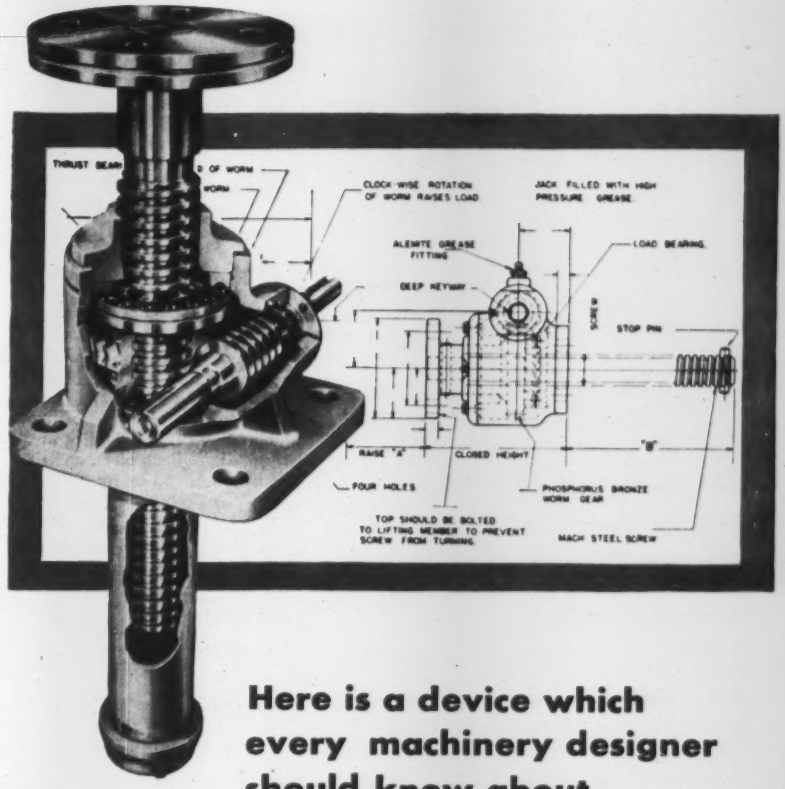
A new type of magnetic core for transistorized electronic computers has been developed by National Cash Register Co., Dayton 9, Ohio.

Development of the N400-080 ferrite core is expected by the company to have considerable significance in the computer industry, since it is said to offer the greatest stability yet achieved for a transistor-operated core over a wide range of temperatures, currents and other disturbing influences.

In maintaining a ratio of 3 to 1 or better between a Read 1 and a Read 0, the drive current used with one of the new cores can vary $\pm 7^1/_2$ per cent in the 300 to 400 ma range, over a temperature range of 50 to 100 F. In the 100 per cent testing procedure applied to the new cores, more than 600 half pulses are applied in checking the above mentioned 3 to 1 ratio.

The new core was developed for NCR's forthcoming 304 electronic business data processing system. The 304 system uses transistors throughout instead of vacuum tubes. A 304 system will require up to 320,000 magnetic cores, wired in matrices in a single memory unit about the size of a television set, the firm states.

The company will make the cores available to other manufacturers. Marketing will be handled through the company's Special Products Dept.



Here is a device which every machinery designer should know about . . .

DUFF-NORTON WORM GEAR JACKS

Duff-Norton worm gear jacks provide a purely mechanical means for accurate positioning of loads weighing as much as several hundred tons and maintaining them indefinitely without creep. They will operate in any position, and functioning as components of machinery and equipment they can raise and lower loads, apply pressure or resist impact. Jack capacities range from five to 50 tons. When two or more jacks are connected by means of shafting and mitre gear boxes they lift in unison, even when the load is unevenly distributed. They are available with standard raises up to 25 inches, and will provide exactly the same raise for years without adjustment. Worm gear jacks are suitable for operation at ambient temperatures up to 200°F.

Thousands of these jacks are in use on feeding tables, tube mills, welding positioners, pipe cut-off and threading machines, testing equipment, aircraft jigs, loading platforms, rolling mills, conveyor lines, arbor presses, and numerous other types of equipment. If you have a positioning problem, write for complete information, requesting bulletin AD-34-FF, which includes drawings and full specifications.

DUFF-NORTON **Duff-Norton Jacks**

DUFF-NORTON COMPANY

P. O. Box 1889 • Pittsburgh 30, Pennsylvania

COFFING HOIST DIVISION: Danville, Illinois

Ratchet Jacks, Screw Jacks, Hydraulic Jacks, Special Worm Gear Jacks, Ratchet Hoists, Electric Hoists, Load Binders, Spur Gear Hoists

Pantex SPEEDYLECTRIC STEAM GENERATOR

Ideal Answer to
10 PROBLEMS
in Supplying Steam

- **Without flame, flues or stack**
- **At higher pressures or temperatures**
- **At adjustable pressure or temperature**
- **With a constant high quality**
- **Without long steam lines**
- **To serve summer processing needs**
- **To meet extra load needs**
- **For lab, test, or pilot-plant use**
- **Where an unattended boiler is desired**
- **Where boiler space is limited**

In many such situations, a Speedylectric Steam Generator is the best or only solution. Using the electrode method of generating steam electrically, completely safe anywhere, its design eliminates low-water hazard and practically removes the need for supervision. Generation is fast, by the simplest and most economical electric method, and adjusts automatically to meet load demand. Upkeep is nil . . . there are no coils, tubes or heating elements to scale or burn out. Sizes from 2 to 50 Bhp, 15 to 500 psi. Higher pressures are available. Electric power 220, 440, or 550 volts A. C. UL listed, ASME code.

FOR YOUR FILE

Send for Bulletin SG-100: operating principles, application features, detailed specifications for complete line.

PANTEX MANUFACTURING CORPORATION
Box 660AJ, Pawtucket 8, R. I.
Send me Bulletin SG-100 . . . free

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KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Set-Up Blocks

New aluminum alloy multi-step set-up blocks said to be soft enough to prevent damage to machine table finish yet strong enough to withstand heavy weights under clamping pressure are announced by Jergens Tool Specialty Co., 712 East 163rd St., Cleveland 10, Ohio.

The new blocks, mounted on 3-in. risers, hold work from 0 to 3 in. and can be pyramided to any desired height. The T-base riser blocks require a minimum of table space but maintain complete rigidity at all height, the firm says. Each block and riser is interlocked by a boss and cavity.

Designed for use for faster set-ups on jig borers, boring mills, drill presses, planers, the blocks come in sets of two multi-step blocks and two risers per package.

BUSINESS NOTES

Moves into New Building

Acme Chain Corp., has moved into a new $800,000 building in the Springdale Industrial Park, Holyoke, Mass. The firm, which produces roller chain, has installed $100,000 worth of new equipment. Officials of the company say the new one-floor building is enabling it to streamline production operations.

Mobile, Miami Offices

Establishment of a new branch sales engineering office at 461 Government St. in Mobile, Ala. has been announced by American Blower Div., American-Standard.

Establishment of a new branch sales engineering office at 220 Miracle Mile, Miami, Fla., has also been announced.

Dealer, Branches Announced

Appointment of a new dealer and establishment of two new branch offices of existing dealers have been announced by Industrial Truck Div., Clark Equipment Co. Trucktor Corp., 1137 Route 22, Mountainside, N. J., has been named to sell and service the fork-lift trucks, powered hand trucks and towing tractors. The firm will handle the Clark line in the New Jersey counties of Hunterdon, Somerset, Union, Middlesex and Monmouth, and Richmond County (Staten Island) in New York.

Morrison Industrial Equipment Co. has established a branch office at 841 Barney St., Muskegon, Mich. The firm's headquarters are in Grand Rapids, Mich., and it has other branches in Jackson, Kalamazoo, and Lansing, Mich.

Wisconsin Industrial Truck Co., Inc., has established a branch office at 201 S. Broadway, De Pere, Wis. Headquarters of the firm are in Milwaukee, and it has another branch in Powers, Mich.

Mechanical Engineers control design and development in . . .

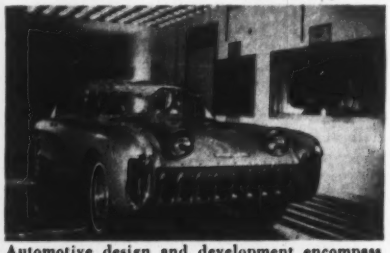
automation

Complex mechanical designs are required throughout this electronically controlled milling machine.

aeronautics

From the ground up, it takes 14 kinds of mechanical engineering to design this supersonic ramjet.

automotive



Automotive design and development encompass body, chassis, power plant, and even accessories.

Throughout industry the 40,000 mechanical engineers who read MECHANICAL ENGINEERING are basic for industrial advertisers. In no other publication can you reach so many mechanical engineers, at such low cost.

Mechanical engineers are educated to specify and buy!

Mechanical Engineering

Published by The American Society of Mechanical Engineers
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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Press Dealers Appointed

R. L. Crane Machinery Co. has been named Buffalo-Jamestown, N. Y., area sales distributor for presses made by Hamilton Div., Hamilton, Ohio, of Baldwin-Lima-Hamilton Corp. Ogden R. Adams, Inc., has been named Rochester, N. Y., area sales distributor. They will sell all types and sizes of mechanical and hydraulic and compacting presses, including plastics and metal powder compacting types.

Sales Representatives

A. W. Cash Co., Decatur, Ill., has announced the appointment of three new sales representatives for its lines of pressure, temperature, hydraulic, process, and combustion control equipment.

The new representatives are Union Steam Power (Pty.) Ltd., Lawson's Corner, Box 6121 Johannesburg, South Africa; Panama Electric & Machinery Corp., Apartado 1432, Panama, R. P.; Engineered Instrument Sales Co., Box 9947, Memphis 12, Tenn.

South Michigan Dealer

Aldrich Pump Co., Allentown, Pa., manufacturer of power pumps and hydraulic equipment, announces the appointment of the DuBois-Webb Co., Detroit, Mich. as exclusive sales representative for the company's products in the southern peninsula of Michigan. The firm will handle the complete line, which includes direct-flow reciprocating plunger pumps, variable stroke pumps, hydraulic accumulators and alleviators.

LATEST CATALOGS

Teflon Gaskets, Rings

A line of gaskets, back-up rings and O-rings made of Teflon to resist acids, alkalis, corrosives and solvents at temperatures from −120 to 500 F are described in a brochure issued by Crane Packing Co., Dept. MXN, 6400 Oakton St., Morton Grove, Ill.

Information is given on service and mechanical aspects of the materials, and operating pressures, standard sizes and dimensions are detailed.

General Purpose Computer

A four-page illustrated report describing how a Bendix G-15 general purpose computer has been integrated into a customer-engineering-manufacturing system, simplifying the calculations and layout work required in the design and detailing of gear shaper cutters, shaving tools and master gears, is available from Bendix Computer Div., Bendix Aviation Corp., 5630 Arbor Vitae St., Los Angeles 45, Calif.

Superb Performers

AURORA APCO *Turbine-Type*

AURORA *Always* PUMPS

AURORA® *Centrifugal*

for EVERY LIQUIDS HANDLING JOB in INDUSTRY

ASK for CONDENSED CATALOG M-9

The engineer-favor accorded "PUMPS by Aurora" rests squarely upon performance satisfaction. Why not let Aurora precision and quality serve your requirements, too?

AURORA APCO *Turbine-Type* PUMPS

are available in SINGLE STAGE • TWO STAGE • FOUR STAGE • WATER JACKETED • STAINLESS STEEL or SPECIAL METALS for "1001" DUTIES.

AURORA *Centrifugal* PUMPS

are available in SINGLE and TWO STAGE HORIZONTALLY SPLIT CASE • SIDE SUCTION • VERTICAL • NON CLOG • SUMP • MIXED FLOW • SPECIAL DESIGN ETC.

DISTRIBUTORS IN PRINCIPAL CITIES

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THE NEW YORK AIR BRAKE COMPANY

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GENERAL MOTORS Corporation

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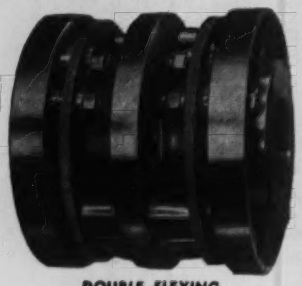
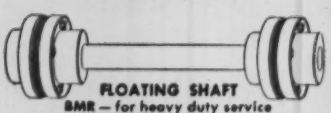


DOUBLE FLEXING
DBZ — for high speed, heavy duty drives



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BMR — for heavy duty service with excessive misalignment

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4 Visual Inspection While in Operation
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Write for Engineering Catalog 51-A

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U. S. A.

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Stainless Steel Hinges

A bulletin issued by Star Stainless Screw Co., 655 Union Blvd., Paterson 2, N. J., lists stainless steel hinges.

Covering more than 30 different sizes in continuous or piano type stainless steel hinges as well as butt hinges, fixed pin type and loose pin type, the bulletin shows length, gage, pin, joint and open width measurements. The bulletin also points up proper specifications for sound hinge practices and gives suggestions for efficient ordering.

Automatic Valves

A 12-page condensed catalog featuring its line of automatic valves is available from A. W. Cash Valve Mfg. Corp., 666 E. Wabash Ave., Decatur, Ill.

The catalog covers main uses, installation tips and construction features along with specification tables for each principal series of valves. Cut-away illustrations show how each type of valve is designed.

Tandem Strip

New catalog literature on its Series 233, 234 and 235 tandem strip fasteners has been completed by Prestole Corp., 1345 Miami St., Toledo 5, Ohio.

Pages include drawings of parts showing measurements, data on various materials from which the part can be made, complete part numbers, minimum and maximum dimensions, length, width, thickness.

Valves, Driers

A catalog on valves, driers, strainers and accessories for refrigeration, air conditioning and industrial applications has been released by Henry Valve Co., 3215 North Ave., Melrose Park, Ill.

Included in the catalog are the standard line of products and a new series of packless valves, pressure sealed driers, liquid indicators, including the fused glass type, and cast bronze strainers.

New Portable Fans

New Aerovent portable utility fans and mancoolers are described and illustrated in four-page Bulletin 250-A, published by Aerovent Fan Co., Inc., Piqua 42, Ohio. Heavy-duty all-purpose units for spot cooling, drying or processing, with 2, 4, or 6 blades. Sizes from 16 to 48 in., for all types of portable or stationary applications.

Continued on Page 70

For Consulting Engineers

Turn to Page 148

BINDERS

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These Binders are well constructed, open flat; hold the publications firmly; and permit insertion, removal and transposition of contents easily. They are made of durable cloth, have identifying title stamped on the spine, and are 9″ x 12″ in size.

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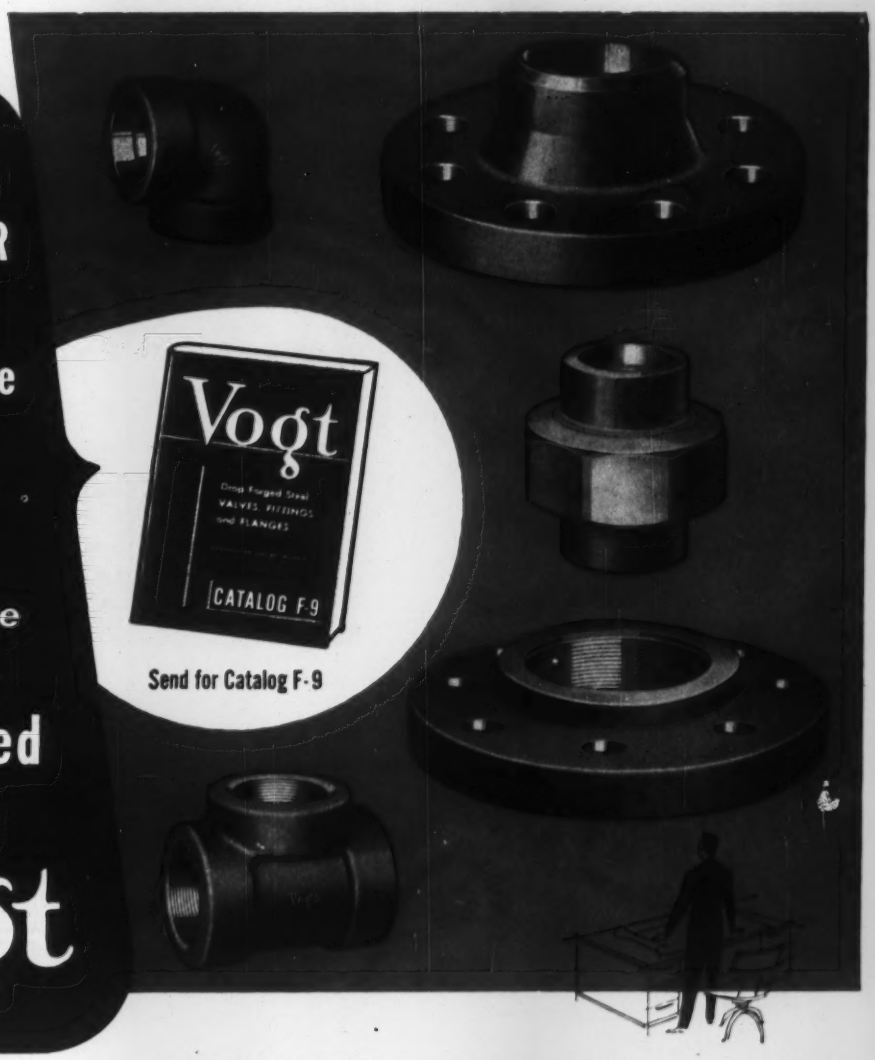

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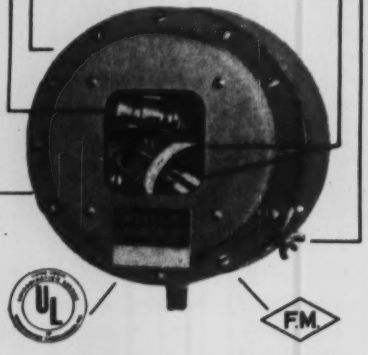

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WRITE FOR BULLETIN 6-18

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KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Steel Descaling

An eight-page booklet on mechanical descaling of steel has been published by Wheelabrator Corp., 1149 S. Byrkit St., Mishawaka, Ind.

The booklet contains a discussion of the alternatives open to steel users for obtaining the required cleaned steel and gives a detailed description of how one plant has saved $7 a ton on steel costs.

Distribution Transformer

A 16-page bulletin, "Distribution Transformers for Rural and Industrial Substations" (75 to 500 kva, 67 kv and below, single phase), has been released by Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

The bulletin describes the materials and various production steps used in producing this type of transformer. It includes a summary of weights and dimensions along with outline drawings, and EEI-NEMA standard accessories for the various sizes. The bulletin is designated No. 61B6014C.

Outdoor Fork Truck

A four-page brochure, Bulletin YR-60-A, describing features, specifications and operating characteristics of the YR-6024, a 6000 lb capacity fork truck for outside handling, is available from Industrial Truck Div., Clark Equipment Co., Battle Creek, Mich.

Specifications given include weight, length, width, wheel base, underclearance, turning radius and tire sizes. Charts indicate tractive effort and gradeability in both high and low range. Features described include planetary drive axles, twin hoist units, upright assembly and gas-powered 68 hp engine.

Investment Castings

A series of brochures containing detailed case histories of successful investment castings applications is available from Alloy Precision Castings Co., Dept. M.E., 3855 W. 150th St., Cleveland 11, Ohio.

The literature presents a view of the entire investment castings field. The firm produces castings by both frozen mercury and lost wax processes. According to the company, utilizing both casting methods gives it an extreme size range from $^1/_{10}$ oz - 100 lb in practically all castable metals.

Weld Nuts

MacLean-Fogg Lock Nut Co., 5535 N. Wolcott Ave., Chicago 40, Ill., has issued a four-page brochure describing projection pilot type and recessed type weld nuts.

The brochure contains information on sizes, dimensions and specifications as well as various features. It describes advantages of weld nut use in the assembly of manufactured products; and outlines the advantages in the simplification of engineering and design through the use of weld nuts.

Glassed Pump

A new glassed centrifugal pump for handling corrosive liquids in the chemical process and allied industries, designed by Goulds Pumps, Inc., Seneca Falls, N. Y. and Pfaudler Co., Rochester, N. Y., is described in Goulds Bulletin 725.2.

Available in heads up to 140 ft, the Fig. 3708 is built in four sizes for capacities up to 700 gpm. All parts of the pump coming in contact with corrosive materials are glassed and resistant to all acids except hydrofluoric at 212 F and alkalis up to pH of 12 at 212 F.

Back Pressure Valve

A catalog sheet available from Atlas Valve Co., 280 South St., Newark 5, N. J., describes its No. 1605 spring-loaded dual purpose relief and back pressure valve, designed to function on both condensing and noncondensing systems.

In condensing systems the valve is used to maintain constant back pressures in the exhaust line from an auxiliary engine or turbine. On the condenser of any auxiliary equipment it functions as a relief valve if the vacuum is lost. In noncondensing systems the unit serves as a back pressure control valve.

VISCOSITY OF LUBRICANTS UNDER PRESSURE

This Report reviews twelve experimental investigations made in England, Germany, Japan, Russia, and the United States on 148 lubricants comprising 25 fatty oils, 94 petroleum oils, 17 compounded oils, and 12 other lubricants. Data collected are co-ordinated by means of sixty tables in which the results originally appearing in diversified units are compared. The methods proposed for correlating viscosity-pressure characteristics of oils with properties determined at atmospheric pressures are reviewed and illustrated. Pertinent topics such as experimental work on heavily loaded bearings, lubrication calculations, and additional techniques for viscosity are covered. Conclusions and recommendations are presented. Other sections give the required computation of temperature and pressure coefficients, a bibliography of 189 items, and symbols.

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29 W. 39th St. New York, 18.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Heavers, Plugs

Information on Vac-tite compression multi-headers and plugs is offered in a 16-page catalog condensing more than 10,000 different types of hermetic seals manufactured by Hermatic Seal Corp., Dept. ME, 29 S. 6th St., Newark 7, N. J.

Parts are grouped to provide essential information, part numbers are simplified, and dimensioning standardized. Drawings and illustrations are included.

Small-Case Instruments

Fischer & Porter Co., 212 Jacksonville Rd., Hatboro, Pa., has published a catalog, No. 51-1450, describing its new small-case instrument line for indicating, transmitting and controlling pressure and temperature.

The instruments—to be called the Series 1450 line—are housed in fiber glass cases. Other features include wide temperature and pressure ranges and a variety of instrument controller options.

Frequency Measurements

Data File 111, describing the many ways Eput and frequency meters can be used is ready for distribution by Beckman/Berkeley Div., Dept. 7248, 2200 Wright Ave., Richmond 3, Calif.

The 17-page booklet covers measurement of low to UHF frequencies, rotational velocity, flow, pressure, temperature, and strain. It also covers telemetry and setting up a secondary standard of frequency.

Air Engineering Folder

New 24-page Air Engineering Data File, Bulletin E-57, published by Aerovent Fan Company, Inc., Piqua 42, Ohio, covers engineering and test facilities for propeller fans, specifications, construction, maintenance, and installation.

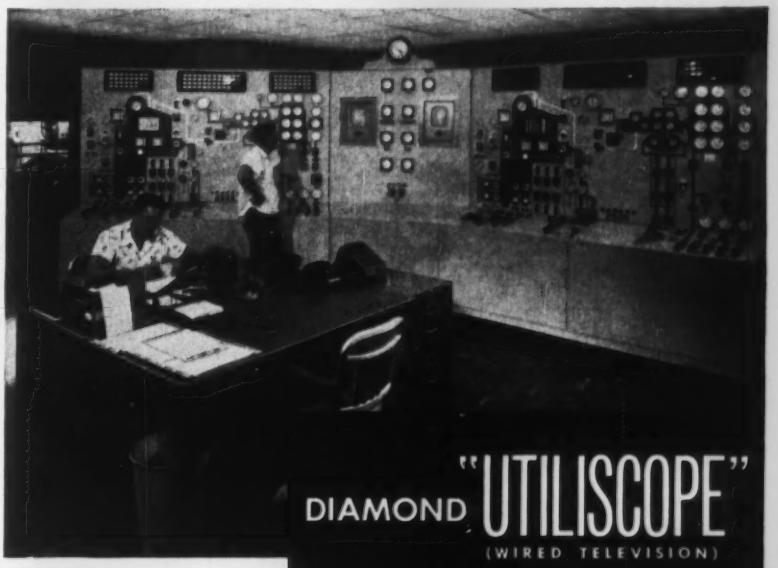
Helpful tables for estimating air-handling requirements, entrance and elbow losses and duct sizes are found in this new folder. Also included are specifications for special propellers, coatings and motors, corrosion-resistance and temperature guides, physical fan laws, terms and definitions.

Gearmotors, Package Drives

A new eight-page booklet, No. DB-3650, on gearmotors and package drives is available from Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

Horizontal, vertical, right angle, open, enclosed, explosion-proof, a-c and d-c units are illustrated with their respective reduction ratios, and output speeds. The gearmotors are designed in accordance with AGMA classes I, II, III and range in speed from 7.5 to 780 rpm.

AUTOMATION IN POWER PLANTS



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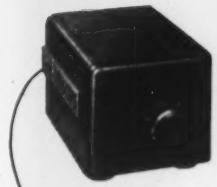

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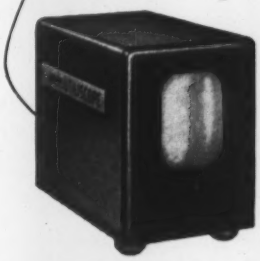

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The Diamond "Utiliscope" makes possible the ultimate in automation for power plant control. It enables the operator to see clearly anything that requires visual check. He no longer need depend upon indirect interpretations to know what is happening outside his range of vision.

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Recent EE, ME Graduate Inquiries Also Invited

THE ELECTRONICS DIVISION
GENERAL MOTORS CORP.
Flint 2, Mich. Milwaukee 2, Wis.

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Self-Locking Nuts

A 36-page illustrated brochure, Bulletin 5711, which presents the firm's progress and status in the field of miniaturized self-locking nuts for electronic units and avionic equipment has been prepared by Elastic Stop Nut Corp. of America, 2330 Vauxhall Rd., Union, N. J.

Major sections cover size and weight reduction and fastener configuration and the relative importance of each factor in choosing the right fastener for the particular job. Comparison charts show weight, size, temperature and material for nuts in hex and clinch series. Standard AN parts and NAS miniatures are compared in chart form.

Utility Sets

A 52-page illustrated two-color catalog, Bulletin 8314, describing Sirocco utility sets is available from American Blower Div., American-Standard, Detroit 32 Mich.

The catalog illustrates and describes various size ranges and configurations of fan wheels and motors available. Features and advantages of the units are explained and illustrated.

Gas Fork Trucks

Gasoline or LPG-powered fork lift trucks with capacities of 5000 and 6000 lb are described in two new bulletins available from the Baker-Raulang Co., Cleveland 2, Ohio.

Bulletin 1348A covers the Model FG-60, and Bulletin 1395 covers the Model FG-50. Features of the trucks include engine, transmission, and drive axle coupled into an integral unit, absence of cowl for good visibility, and self-equalizing brakes with single-point adjustment.

Meter-Relays

Automatic control with miniaturized non-indicating meter-relays is described in 12-page Bulletin 104-A, issued by the San Gorcinto Div., Assembly Products, Inc., Palm Springs, Calif.

Features of the bulletin, which includes complete circuitry information, are a new and smaller Model 126 VHS meter-relay, and several models of the Compact, a plug-in control package using the VHS. Sensitivity of the VHS begins at 0.2-μa or 0.1-mv, yet it will withstand shock and vibration up to 20 G's.

Gravity Conveyor

Application ideas and features of Rapistan flow track are described in a bulletin, No. FT-57, published by Rapids-Standard Co., Inc., 342 Rapistan Bldg., Grand Rapids, Mich.

The flow track, which is gravity conveyor in its basic form, can be combined with other conveyors or be used in various combinations of itself. The bulletin illustrates applications and includes specifications.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Tubular Heaters

General Electric Co., Schenectady 5, N. Y., announces publication GEA-5866, 16 pages, consisting of case histories of successful use of tubular heaters by machinery manufacturers on such built-in applications as shrinking machinery, extruding machines, radiant ovens, and paint heaters.

Ball Joints

How to handle thermal expansion and contraction in piping with ball joints is outlined in a six-page bulletin, No. 31, published by Barco Mfg. Co., Dept. J 24, 501 Hough St., Barrington, Ill.

Illustrations of four basic motion principles of ball joints are shown, along with actual installations. Comparison data with other methods of expansion-contraction control is given.

Blast Cleaning Machines

Descriptive bulletins on four new continuous Tumblasts, airless abrasive blast cleaning machines, are announced by Wheelabrator Corp., 1149 S. Byrkit St., Mishawaka, Ind.

They cover the 15, 36, 48, and 60 in. units with a new end-discharge construction in which work to be cleaned passes through the machine at a continuous rate. Operating labor is not required for these machines, the firm states. Diagrams, line drawings, and cutaway illustrations are included with specifications and dimensions.

Heating Element Alloy

A catalog-manual covering Chromel-D, a 35-20 nickel-chromium-iron heating element alloy recommended for use in controlled atmosphere furnaces operating at temperatures up to 1800 F, is available from Hoskins Mfg. Co., 4445 Lawton Ave., Detroit 8, Mich.

The 12-page illustrated publication, designated M-55D, lists prices and specifications on the alloy as supplied in wire, ribbon and furnace strip form. Also included is a temperature-resistance curve, tables giving resistance tolerances and physical properties, and basic factors to be considered in designing furnace strip elements, rod elements and coiled wire elements.

Properties of Steam at High Pressures

This is an interim steam table covering a range from 5500 to 10,000 psi and 32 to 1600 degrees F. It is published to provide a reasonable extrapolation of the current tables that will be useful in power systems calculations until an authoritative steam table has been published—five years hence.

1956 $1.00 20% Discount to ASME members

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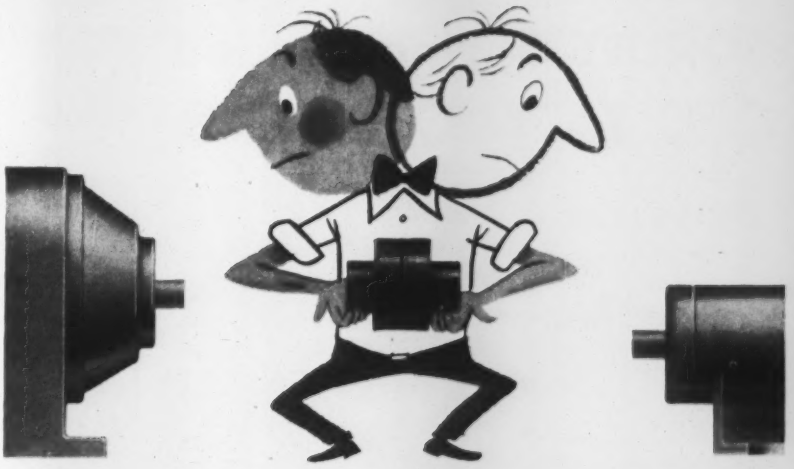
why limit yourself to SHORT couplings?



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CLUTCHES

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Floatless Transmitter

A new system for transmitting water or waste flow measurement from a Parshall flume to a flow recorder is described in Application Engineering Data Sheet, 831-35, issued by Foxboro Co., Foxboro, Mass.

As diagrammed, the system consists of a differential pressure cell transmitter which senses back pressure in a bubble tube inserted in the float well. The output of the transmitter, a 3-15 psi air signal proportional to well level, is received by a pneumatic receiver-recorder. A special chart which incorporates the exponents of the flow equation enables flow to be read directly in flow units.

Copies of the two-page sheet are available on request.

Materials Handling Containers

A 16-page catalog designed to describe the company's line of materials handling containers constructed of vulcanized fibre has just been announced by Continental-Diamond Fibre Corp., Newark, Del.

The catalog describes in detail vulcanized fibre trucks, trays, boxes, baskets, seamless roving cans, and barrels. Information provided includes uses, sizes, colors and features of each item presented in the catalog.

Welding Outlets

W-S Fittings Div., H. K. Porter Co., Inc., Box 95, Roselle, N. J., has announced the availability of a four-page bulletin describing its line of couplets branch connections for tanks, pressure vessels and pipelines.

Bulletin CP-1-57 includes dimensional and specification data on the screw-end and socket-welding outlets, and on the 90-deg elbow outlet. Installation details are also described.

Thermostatic Steam Traps

A new line of Quik-Flex thermostatic steam traps for outdoor and nonfreeze service is described in a four-page two-color bulletin published by V. D. Anderson Co., 1935 W. 96th St., Cleveland 2, Ohio.

Bulletin No. 257 itemizes uses for the traps in such outdoor service tracer lines, meter boxes, drips and steam processing equipment found in chemical, refinery, solvent and greenhouse operations.

Self-Locking Bolts

A two-color four-page folder describing the principal features and advantages of Nylok self-locking bolts has been published by the Bolt and Chain Div. Republic Steel, 3100 E. 45th St., Cleveland 27, Ohio.

According to the folder, the bolts solve fastening problems involving adjustment, liquid sealing, and vibration without extra locking devices or wiring. They provide a positive lock, seated or not, and they can be reused without affecting the tightness of the seal, according to the firm.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Electric Chain Hoist

A bulletin, describing the manufacturer's new electric chain hoist available in two types of reeving has been issued by the Wright Hoist Div., American Chain & Cable Co., Inc., York, Pa.

Designated as Bulletin DH-73, the four-page folder presents data on construction details, weights, capacities, lifting speeds, dimensions.

Propeller Fans

A revised catalog, Bulletin A-109C, covering its line of propeller fans, has been published by Hartzell Propeller Fan Co., Piqua, Ohio.

The catalog contains new fan sizes as well as revised air deliveries, specifications, performance data and dimensional drawings, on the entire line. Standard propeller, utility, cool-blast, Lo-Noise, reversible and bi-pass duct fans, intake air units and unit heaters are shown.

Pneumatic Power Drive

Bulletin No. 1033, recently published by Copes-Vulcan Div., Blaw-Knox Co., Erie, Pa., describes pneumatic power drive units designed for the remote operation and positioning of valves, dampers, louvers, rheostats, vanes and variable-speed drives.

The four-page bulletin explains the principle of operation including operating characteristics, and gives mechanical specifications. A table of sizes, torque ratings and weights, torque output curves and dimensional drawings provide all data needed to design these devices into a control system.

Fork Trucks

An eight page, four-color catalog describing the construction, operating characteristics and specifications of the new Ranger line of fork trucks for outdoor handling is available from the Industrial Truck Div., Clark Equipment Co., Battle Creek, Mich.

Models of 15,000, 20,000 and 30,000 lb capacity are treated in the catalog. Schematic drawings illustrate the torque converter, power-shift transmission, nonsteering drive axle and steering drive axle designed especially for the equipment. Sketches describe the brake system and differential locking device used to distribute power equally to all wheels. Tables and charts give information on operating features and specifications.

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CORROSION

TYPE	HOW TO IDENTIFY
GALVANIC	Localized deep grooves or pits, often at contact between dissimilar metals.
UNIFORM	Uniform attack—may be on only one part.
INTERGRANULAR	Attack at grain boundaries.
PITTING	Rapid, deep pitting at several small areas. May be uniform or highly localized.

Why you can conquer all four kinds of corrosion with Goulds chemical pumps

When you buy Goulds Fig. 3715 chemical pumps you can build *specific* protection against all four types of corrosion.

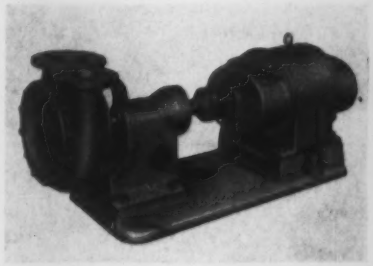
Match the pump metal to your liquids. You can have the *entire* fluid end of the pump made of 316 stainless, Gould-A-Loy 20, nickel aluminum bronze, iron, iron with stainless trim or nickel aluminum bronze trim. These metals from stock. Any machinable alloy on application.

All machined parts in all metals held to same close clearances permitting economical alloy changes in the field . . . the entire liquid end or any component as conditions warrant.

Choosing from this wide range of metals, you can combat the different corrosive actions of hot acids, alkalies, slurries, sizes, or whatever other corrosive liquids you pump.

Match pump size to job

You can get Goulds Fig. 3715 in 9 sizes: capacities to 720 GPM, heads to 200 ft. Other features of Fig. 3715: water-jacketed support head permits handling liquids at 350°F.; impeller clearance can be adjusted without dismantling the pump. For more information, write for Bulletin 725.4.



These larger pumps also fight corrosion

For larger capacities or heads, you can get these other Goulds pumps in metals that resist specific corrosion:

Fig. 3405—single stage, double suction; 19 sizes; capacity to 6400 GPM, head to 425 ft. Bulletin 721.6. Popular sizes available in 316 stainless steel from stock.

Fig. 3305—two stage, opposed impellers; 8 sizes; capacity to 1200 GPM, head to 1000 ft. Bulletin 722.6.

Fig. 3189—single stage, open impeller; 11 sizes; capacity to 1080 GPM, head to 180 ft. Bulletin 720.4.

Goulds PUMPS INC. Seneca Falls New York

Branches: Atlanta • Boston Chicago • Houston New York • Philadelphia Pittsburgh • Tulsa

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In Canada: The A. R. Williams Machinery Co., Ltd. in all principal cities.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Leaded Steels

A 16-page booklet offered by the Copperweld Steel Co., Steel Div., 4039 Mahoning Warren, Ohio, presents information on basic characteristics, mechanical properties and workability of leaded steels.

Test results are supported by data and charts. The booklet also contains several pages of case histories based on manufacturers' experience and documented by time study records.

Silicone Insulation

The value of rewinding motors with silicone insulation is appraised in dollars-and-cents terms in a brochure published by Dow Corning Corp., Midland, Mich.

Featured are several complete case histories, some dating back to eleven years ago when silicone insulation first became commercially available. Applications range from a single 6 hp unit in a one-owner laundry, to a line of 300 hp giants in the world's largest magnesium plant. Also included is a brief description of what silicone insulation is, its history, and its importance to motor maintenance men.

Pressure Control Valves

A new bulletin on the Cash Standard Types 4030 and 4430 back pressure control valves has been published by A. W. Cash Co., Box 551, Decatur, Ill.

Designed for use in refrigeration systems, the valves are said to maintain a constant back pressure in the evaporator. They can also be used with air operated temperature controllers to regulate back pressure in the evaporator to maintain a desired temperature, the firm states.

Teflon Hose

An industrial engineering bulletin describing the construction and use of its new 2802 industrial hose made of Teflon has been released by Aeroquip Corp., Jackson, Mich.

According to the firm, this is the only hose assembly of Teflon available with reusable fittings. The bulletin provides dimensional data and assembly instructions, and outlines the potential applications of the new hose. Hose lines made of Teflon excel in applications requiring lubricity, nonadhesion of sticky or viscous materials, resistance to temperatures up to 500 F, chemical inertness and extra long wear, the company states.

Motor Starters, Contactors

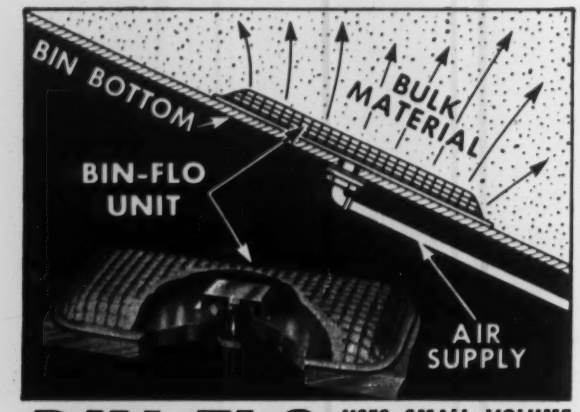
Motor starters and contactors in sizes 4, 5, and 6 (Type 425), 50 to 400 hp, are described in a 12-page bulletin, No. 14B-8615, released by Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

The contactors incorporate Acbo arc centering blowout, a modern principle of arc interruption said to eliminate the need for conventional blowout coils. The device utilizes thermal convection and magnetic action to center, rupture and quench the arc quickly and effectively.

Pressure Gages

The line of helicoid Gages, pressure instruments for industrial, processing and chemical applications, are described and illustrated in a 32-page booklet, Catalog G-52, issued by the Helicoid Gage Div., American Chain & Cable Co., Inc., Bridgeport 2, Conn.

According to the manufacturer, the instruments can be used on such services as engines, turbines, blowers, locomotives, hydraulic presses, tractors, pumps, compressors, or wherever a gage is subjected to violent pressure pulsations or severe mechanical vibrations.



BIN-FLO USES SMALL VOLUME OF AIR AT LOW PRESSURE

KEEPS BULK MATERIALS MOVING

BIN-FLO units in bins, chutes, hoppers, etc., restore flow characteristics to dry, finely ground materials which tend to pack or bridge in storage. Types for all materials and conditions. No moving parts; simple installation; negligible operating cost; no maintenance cost.

BIN-DICATOR the original diaphragm-type bin level indicator. In successful use for over 20 years. **ROTO-BIN-DICATOR** new, motor-driven paddle type; excellent on bins under pressure or vacuum, and for general application. Also explosion-proof units, U.L. listed.

THE BIN-DICATOR CO.
13946-W Kercheval • Detroit 15, Mich.

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With the distribution table, spray uniformity is a measurable quantity . . . and the effects of nozzle design can be accurately tabulated. Here is but one instrument among many used in Spraying Systems research to give you better spray nozzle performance. May we send you complete information?
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A new concept in Roller Chain Design

CONVENIENCE. New ease of coupling and uncoupling for multiple-width chains. Pins are a "glide fit" through inner link plates...a press fit only in the outer link plates.

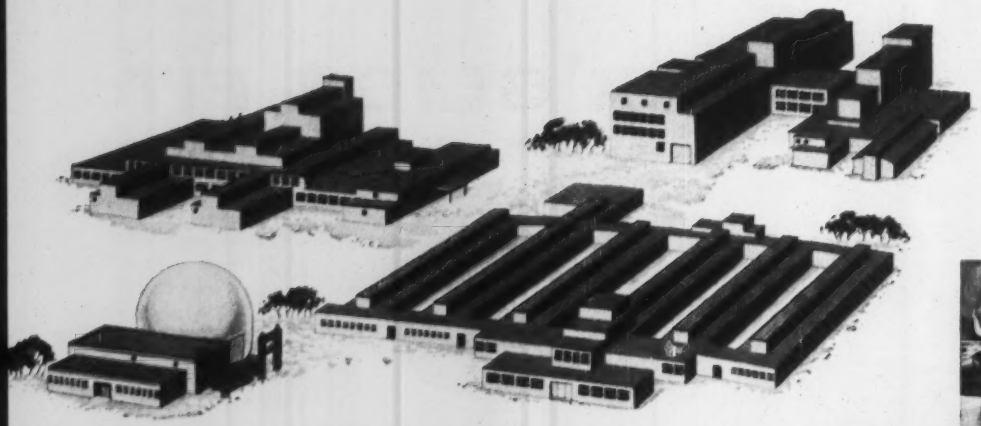
LONG LIFE. You get the great convenience of Rex Glide Fit Roller Chains *plus* long life. Properly applied, there's no sacrifice of life or strength to gain the easy coupling.

ECONOMY. The long life and easy coupling of Glide Fit Roller Chains mean lower operating costs...less nonproductive down time. You can couple these chains *faster*... uncouple them *faster!*

Get the complete story of all the advantages you get with Rex Glide Fit Roller Chains...the new concept in multiple-width chains. Write CHAIN Belt Company, 4765 West Greenfield Avenue, Milwaukee 1, Wisconsin.

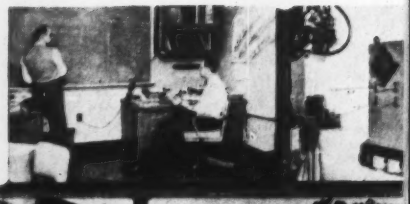
CHAIN BELT

Leadership...through creative engineering



HOME OF LEADERSHIP

Our buildings are too young to be covered with ivy—this is also true of our staff, our ideas, and the problems we work on. What's old fashioned about us is our ability to talk about what we are doing (most of it) with our professional friends and each other. Why not talk to us about the scientific and engineering positions available in this congenial and informal atmosphere?



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Professional Personnel Office • P. O. Box 299 • Lemont, Ill.

HAGAN RING BALANCE FEATURES — NO. 1

TRIGONOMETRY OF

UNIQUE RANGE CALIBRATION SYSTEM PROVIDES HIGH SENSITIVITY AT LOW FLOWS

Low-flow sensitivity is a built-in feature of the Hagan Ring Balance flow meter. Rotation of the ring, in response to differential, is governed by the adjustable range spring in accordance with the unvarying trigonometry of the range calibration mechanism. This is expressed by the formula:

$$\text{Spring deflection} = R(1-\cos\theta) - L(1-\cos\phi),$$

and is graphically illustrated at the right. The upper curve shows that the ring motion at low range exceeds the requirement to produce pen motion linear with flow. Thus, the cam which transmits ring motion to the pen arm can convert this excess ring motion into extra power for precise pen movement.

METERING APPLICATIONS WHICH REQUIRE WIDE TURN-DOWN CALL FOR HAGAN RING BALANCE METERS. You get this feature when you specify Hagan, as well as the following:

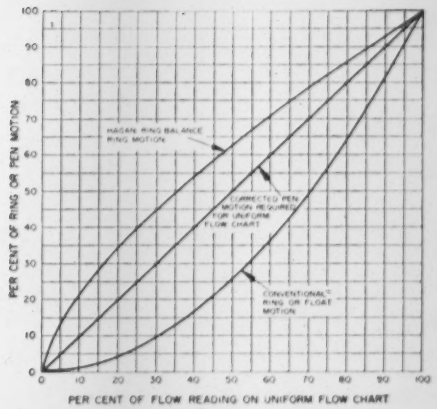
1. Ease of calibration under operating static pressures with factory calibrated check weights! No more four-story water columns and telephones!
2. Safe operation with rings rated at 2,500, 10,000, 15,000 psig. No gaskets, no stuffing boxes.
3. Sealing fluid density and level not critical. No eyedroppers required.
4. Interchangeable ring assemblies for full scale ranges from 0.5" w.c. to 560" w.c. Adjustment on any one ring over a 7:1 differential range.
5. Wide range computation and/or compensation by means of built-in, easily checked mechanisms available on most models.
6. Pneumatic or electric transmission also available.

Bulletin MSP-141 describes these features and the new design of the Hagan Ring Balance meter case. ASK US FOR IT.

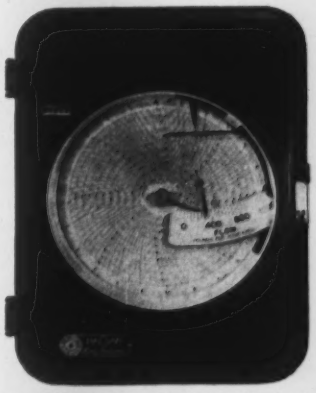
HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY • HALL LABORATORIES

Push rod moves upward against range spring, governing ring rotation in accordance with the diagram below.



Excess motion of the Hagan ring, as shown by upper curve, is converted (with a gain in torque) into linear pen movement by a gently sloping cam.



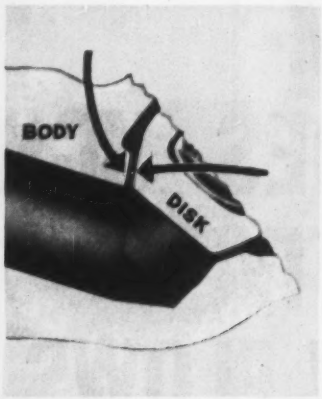
New, rigid, weatherproof, die-cast, aluminum case. Four-piece back for complete accessibility.

How To Make Your FIRST Buy

Rockwell-Edward forged steel inclined

WELDED BONNET CAN'T LEAK

Seal-welded body-bonnet joint maintains pressure tightness in any service. Weld easily removed for disassembly. Threaded section and body shoulder carry pressure load and give accurate alignment. Exclusive Impactor handwheel, shown here, available only on 2½ in. size.

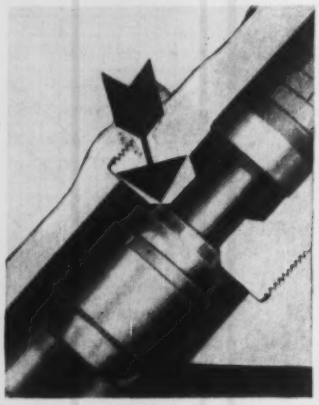


HARD-FACED INTEGRAL SEAT

Continuous Stellite ring (arrows) applied to body and disk retains hardness at high temperature; resists corrosion and erosion. Stellited seat is precision-machined in same set-up as body bore, then carefully lapped to form drop-tight mated seating surfaces.

TIGHT BACKSEAT SAVES PACKING

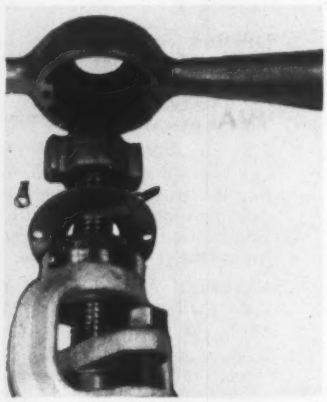
Radiused disk nut contacts plane beveled surface at the bottom of the bonnet, gives high load line contact capable of penetrating oxidation to create complete isolation of packing chamber from line pressure. This minimizes maintenance, increases packing life



CROSS ARM IMPACTOR* HANDLE

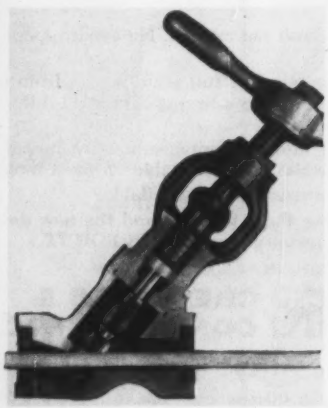
Now the famous Edward Impactor principle is applied to the larger forged steel Univalves. Delivers 2.8 times the closing load of ordinary handwheels. Assures tight seating with minimum effort in minimum space. Knobbed easy-grip handwheel on smaller size Univalves.

*T M. Reg. U.S. Pat. Off.



WIDE RANGE OF USES

For steam, water, oil or gas: wherever pressure and/or temperature demand a dependable high-pressure valve the Univalve will do the job best. One line of standard valves will perform all drain, vent, bypass, blow-down, instrument take-off and all but the most difficult throttling functions. Shown here is a pair of Univalves used for boiler blow-off service.



STREAMLINING CUTS FLOW RESISTANCE

Inclined stem and internal streamlining cut turbulence, reduce pressure drop, minimize wear. Edward scientists incorporate precise streamlining in every Edward valve. Wood dowel through bore of this Univalve demonstrates straight-through design.

Rockwell-Built Edward Valves

The RIGHT Buy In Steel Valves

stem Univalve* is a good example . . .

The original cost of steel valves is often only the *beginning*. Frequently, on the heels of installation, comes a series of repairs (involving cost and service interruption) ending in premature replacement. How much *less* costly it is, in terms of cash and down-time, to buy steel valves which are "right"—right from the start.

This isn't always easy. Some valves scream "price", others assert "quality" without defining what they mean. It remains for Edward, long-time leader in the field, to step forward with a word of quiet assurance.

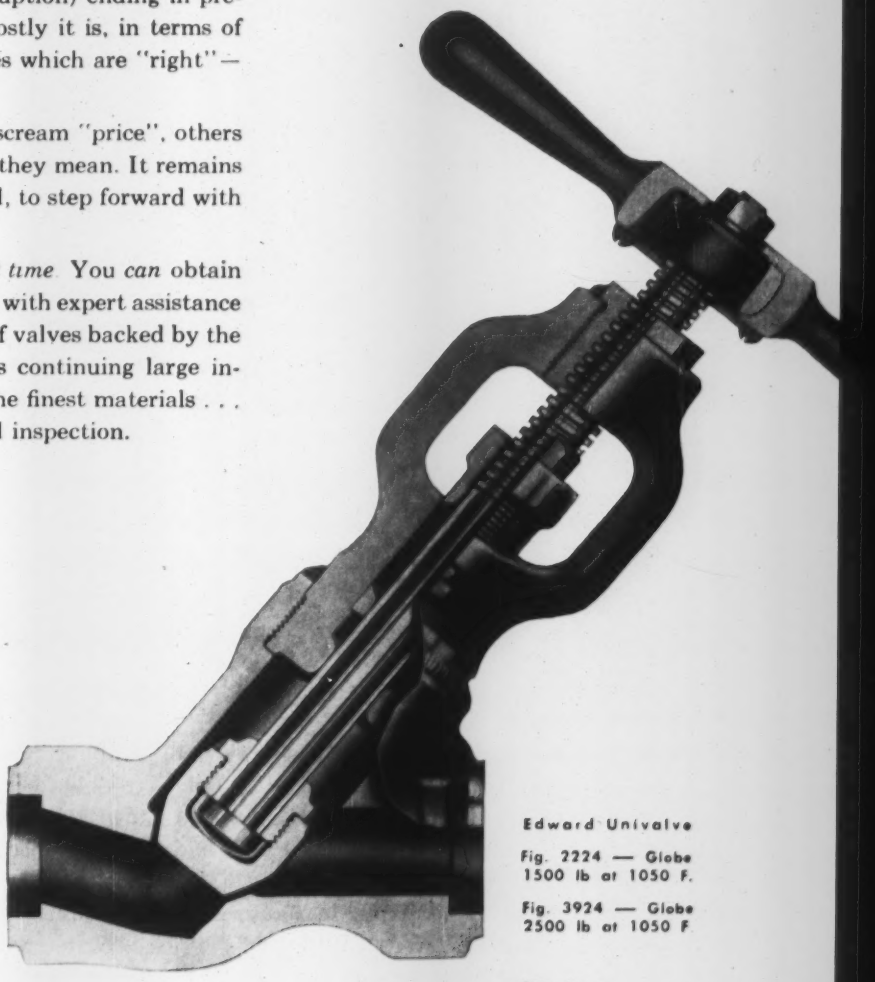
It *is* possible to "buy right" the *first time*. You *can* obtain steel valves exactly right for your needs, with expert assistance every step of the way. You can be *sure* of valves backed by the Edward reputation . . . the company's continuing large investment in valve research . . . use of the finest materials . . . and the most careful craftsmanship and inspection.

UNIVALVE A GOOD EXAMPLE

Edward valves do not cost substantially more than competitive valves. But they give you a *great deal* more for your valve dollar. A case in point is that of the Edward inclined stem Univalve* pictured on these pages. At right, it appears in entirety; at left, upon the facing page, are a half-dozen of the premium features you will find in this valve. They invite your attention.

We respectfully suggest a visit from your Edward Representative. Technically trained, thoroughly experienced, his professional advice can save you headaches and money. There is no obligation, of course. Whether you are interested in steel valves for original installation or for replacement, it will pay you well to get in touch with us *today*.

*T.M. Reg. U.S. Pat. Off. — — Integral seat valves, with body and bonnet a single unit



Edward Univalve

Fig. 2224 — Globe
1500 lb at 1050 F.

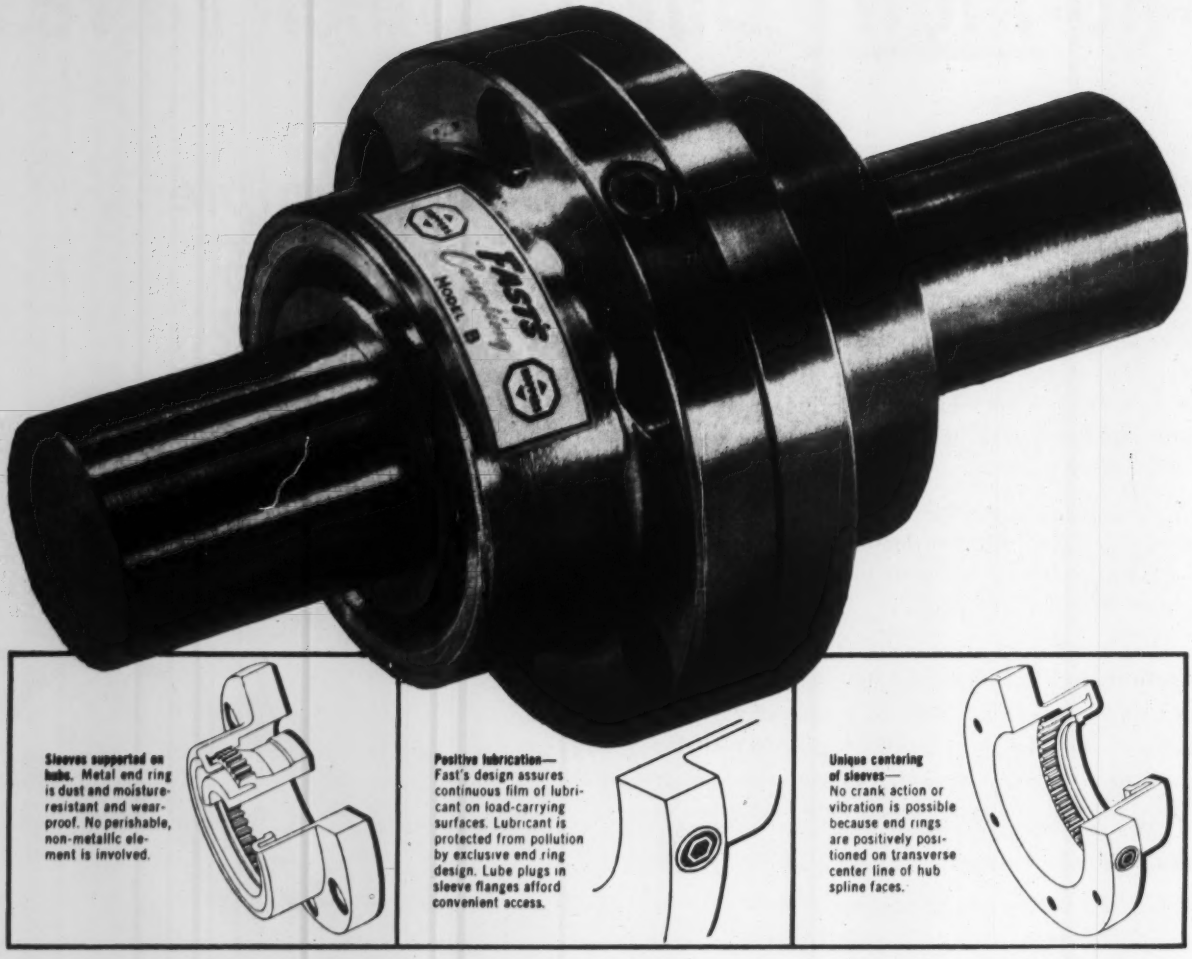
Fig. 3924 — Globe
2500 lb at 1050 F

Sizes from
¼ in. to 2½ in.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

1228 West 145th Street, EAST CHICAGO, INDIANA



Sleeves supported on hubs. Metal end ring is dust and moisture-resistant and wear-proof. No perishable, non-metallic element is involved.

Positive lubrication— Fast's design assures continuous film of lubricant on load-carrying surfaces. Lubricant is protected from pollution by exclusive end ring design. Lube plugs in sleeve flanges afford convenient access.

Unique centering of sleeves— No crank action or vibration is possible because end rings are positively positioned on transverse center line of hub spline faces.

Fast's Model B coupling reduces downtime and upkeep for light-to-medium drives

Mechanical flexibility eliminates costly shutdowns and expensive shaft replacements. But—it's only one of many cost-saving features.

Now you can profit from the durability and economy of famous Fast's couplings in a smaller and lower-cost version—available in 3 sizes for shafts up to 2⅝" in diameter.

The Model B coupling gives you the same features that have made Fast's the world's leading coupling for over 35 years. You get the same trouble-free performance, longer service life and lower maintenance costs. You also get prompt delivery because stocks are on hand to meet practically every need. Free engineering service is also available.

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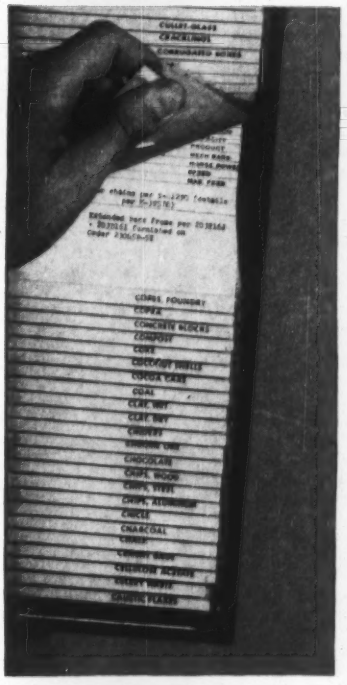
THE ORIGINAL
FAST'S Couplings

Protect your conveyor or elevator belts. Jeffrey's slatted pulley solves sticky problems. Ordinary belt conveyor pulleys often collect sticky or abrasive material on their solid faces. This wears out the belt and gets it out of alignment. Jeffrey's answer is the slatted wing type pulley shown above. It is self-cleaning. Belts last longer. Downtime is greatly reduced. Described in Bulletin 898.

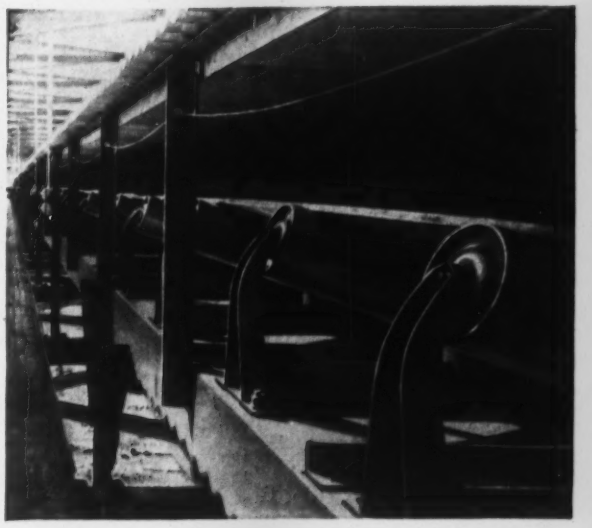
Again and again the White Rock Sewage Treatment Plant at Dallas, Texas, has been expanded. Each time the equipment added has been Jeffrey. Progressive municipalities and industries everywhere are meeting sewage, water and industrial waste treatment the mechanized way. They are looking to Jeffrey engineers for technical assistance, profiting by the many years of experience these men have had in meeting all kinds of treatment needs. They have learned that Jeffrey equipment can be depended upon to perform faithfully and well. Catalog 833-A describes Jeffrey sanitation equipment.

Design JEFFREY into your next plant



The new is often old when you have a problem involving the crushing, pulverizing, shredding or grinding of some material that's strange to your processes. During the past 60 years, Jeffrey reduction equipment has handled almost every conceivable substance. Jeffrey's files contain the history of all tests run on those materials, plus machine performance data. Often we have only to look in these files for the answer to your reduction problem.

A dozen Jeffrey bulletins describe equipment for reducing different materials. For proper data, tell us your problem.



Merchandise. No "soft goods" among the millions of pounds of merchandise which Jeffrey supplies annually. Hard work is the chore of every item—conveyor-belt idlers like those shown here, the miles of power transmission and conveyor chain in use throughout industry, or any of the hundred-odd other Jeffrey products. Materials and workmanship are the finest. Into each has gone Jeffrey's long experience in engineering and building elevating, conveying and processing equipment. Catalog 418 should be in every engineering department file.

We can help you work out the most reliable, efficient and economical solution to problems involving any of the operations described here. Jeffrey engineers are available to advise on methods and they will assist in selecting Jeffrey equipment best suited to each task. For any of the literature mentioned above, and for this engineering help, write The Jeffrey Manufacturing Company, Columbus 16, Ohio.

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Your complete instruction books for determining capacity, efficiency, consumption, and other specified performance of power and heat apparatus

CENTRIFUGAL, MIXED-FLOW AND AXIAL FLOW COMPRESSORS AND EXHAUSTERS, Pub. 1949. $2.00

For testing compressors and exhausters including superchargers and axial-flow compressors in which the change in the gas specific weight exceeds seven per cent, and for testing apparatus handling gases other than air.

CENTRIFUGAL PUMPS, Pub. 1954. $1.50

Provides rules for conducting tests on centrifugal pumps including those of the mixed-flow and axial flow types.

COAL PULVERIZERS, Pub. 1944. $1.50

Defines practice of testing pulverizers used for firing boiler furnaces, kilns, or industrial furnaces of various types.

DISPLACEMENT COMPRESSORS, VACUUM PUMPS AND BLOWERS, Pub. 1954. $2.00

Contains the procedures for testing equipment of this and all rotary type machines which operate on a positive displacement principle.

DETERMINING DUST CONCENTRATION IN A GAS STREAM, Pub. 1957. $2.50

This Code sets forth a procedure for measuring the dust concentration in gas stream confined in a duct. It also contains procedures for making a size analysis of the dust sample.

DUST SEPARATING APPARATUS, Pub. 1941. $2.00

Designed for testing all types of dust separating apparatus installed for operation in conjunction with solid-fuel fired furnaces.

EJECTORS AND BOOSTERS, Pub. 1956. $2.00

These test measurements for ejectors and boosters operating as gas compressors were developed to establish: ejector capacity in relation to inlet pressure; discharge pressure in relation to inlet pressure; the flow rate of the motive fluid in relation to a stipulated pressure and temperature; and the ejector stability; i.e., the relation of motive fluid pressure or its charge pressure to breakdown and recovery of the pumping action.

EVAPORATING APPARATUS, Pub. 1955. $1.50

While these rules were developed primarily for testing evaporating apparatus for producing boiler make-up water, they can also be used as a guide in testing other types of evaporators.

FANS, Pub. 1946. $1.00

Covers the testing of blowers, fans, and exhausters of centrifugal, axial, or mixed-flow types in which the fluid density change does not exceed seven per cent.

FEEDWATER HEATERS, Pub. 1955. $1.50

Designed for testing direct-contact feedwater heaters and closed-type feedwater heaters with or without drain cooler and desuperheating sections. Rules also apply where the heating medium is water as in the case of drain coolers or special coolers, and with slight modification to suit special conditions, they can be applied to heaters that heat water for any purpose when the heating medium is steam.

GASEOUS FUELS, Pub. 1944. $2.00

Presents methods for determining the heat value, specific gravity, moisture content in fuel gas, and specific heat of gases.

GAS TURBINE POWER PLANTS, Pub. 1953. $2.00

Shows how performance-tests of gas turbine power plants and components should be made.

HYDRAULIC PRIME MOVERS, Pub. 1949. $2.00

These instructions are for testing an individual reaction or impulse turbine unit of any type. Code also contains rules for index testing.

RECIPROCATING STEAM-DRIVEN DISPLACEMENT PUMPS, Pub. 1949. $1.00

Outlines the proper method of testing the pump and engine, including reheaters, heaters, and jackets, if any, and jacket pumps, circulating pumps, condensate pumps, and vacuum pumps, which are concerned in their operation.

RECIPROCATING STEAM ENGINES, Pub. 1935 (Reaffirmed 1949) $2.00

Recommends standard testing methods for determining the performance of an engine, including steam jacket if any.

SOLID FUELS, Pub. 1954. $2.50

Here are set forth the methods of testing solid fuels to determine composition, heating value, size, bulk density, pulverizing characteristics or grindability, caking characteristics, dustiness, and classification of fuels by rank.

STATIONARY STEAM-GENERATING UNITS, Pub. 1946. $2.00

For testing of units defined as combinations of apparatus for producing, furnishing, or recovering heat, together with apparatus for transferring to a working fluid the heat thus made available.

STEAM CONDENSING APPARATUS, Pub. 1955. $2.00

A set of rules for testing all apparatus whose primary function is to reduce the exhaust pressure of a prime mover to a pressure below atmosphere, and, in the case of surface condensers to condense the steam so that the condensate is available for re-use as boiler feed.

STEAM TURBINES, Pub. 1949. $3.00

Covers the testing of all types and applications of modern steam turbines and includes complete instructions for making the necessary pressure, temperature, and flow measurements.

APPENDIX TO TEST CODE FOR STEAM TURBINES, Pub. 1949. $3.00

This section facilitates the preparation of steam turbine test reports. It includes numerical examples of many of the calculations involved in reporting tests conducted and also filled-out hypothetical test forms.

Each of these codes contains a check list of the items on which agreements should be reached prior to starting tests, specifies the instruments and testing apparatus required, lists precautions to be taken, gives instructions for computing and tabulating test results, and shows how to correct test results for deviations of test conditions from those specified.

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Whether your application is of bench scale, for a pilot plant, or for high-volume production, you can save by utilizing the flexible facilities of LINDE. You can obtain LINDE gases in liquid or gaseous form... by tank car or tank truck... in manifolded cylinders or in a single cylinder... or from an on-site plant.

For more than 50 years, LINDE has been supplying oxygen and other gases when, where, and in the amounts wanted. For further information, write Dept. ME-8, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. *In Canada:* Linde Company, Division of Union Carbide Canada Limited.

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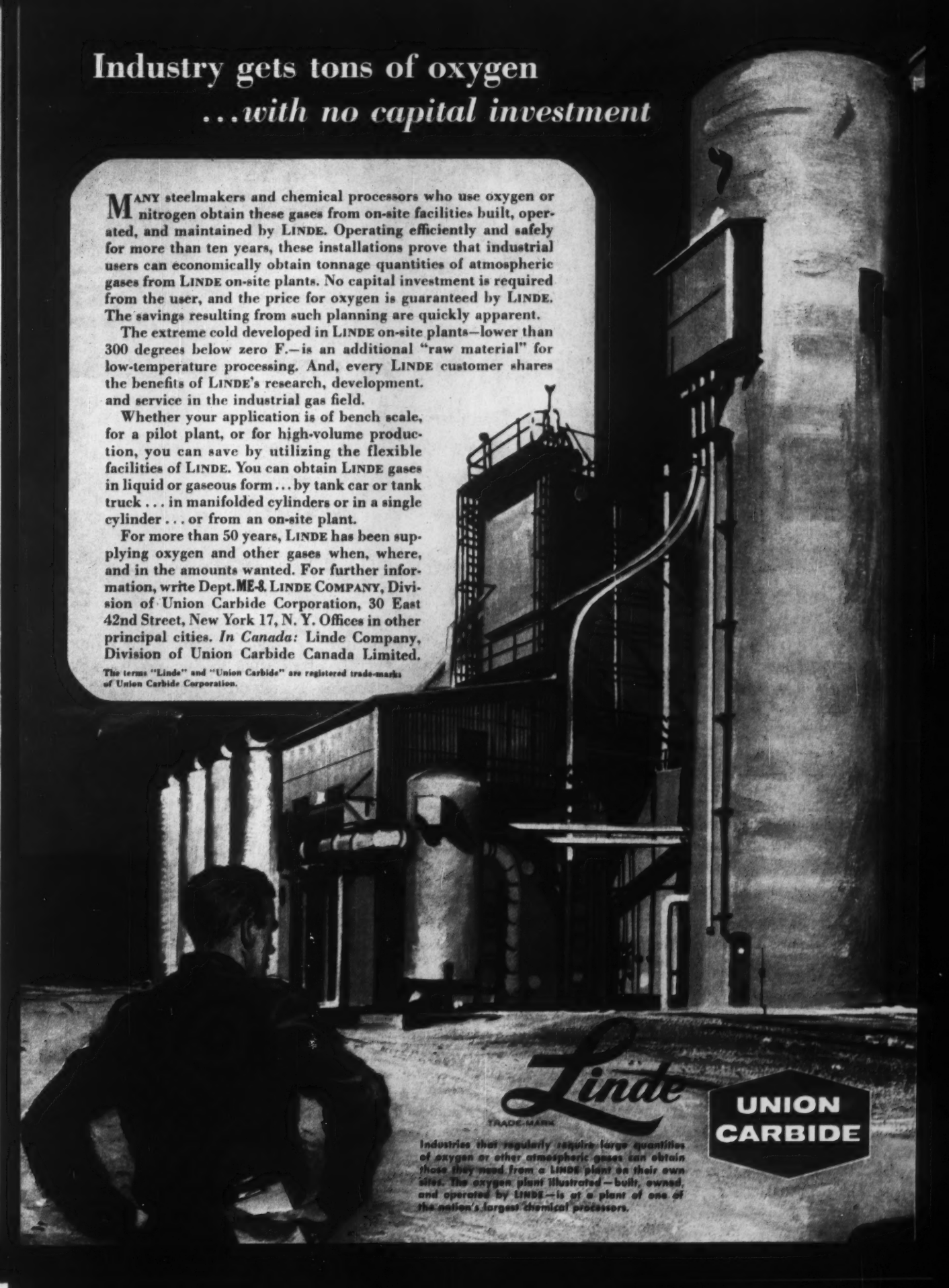

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Industries that regularly require large quantities of oxygen or other atmospheric gases can obtain those they need from a LINDE plant on their own sites. The oxygen plant illustrated—built, owned, and operated by LINDE—is at a plant of one of the nation's largest chemical processors.

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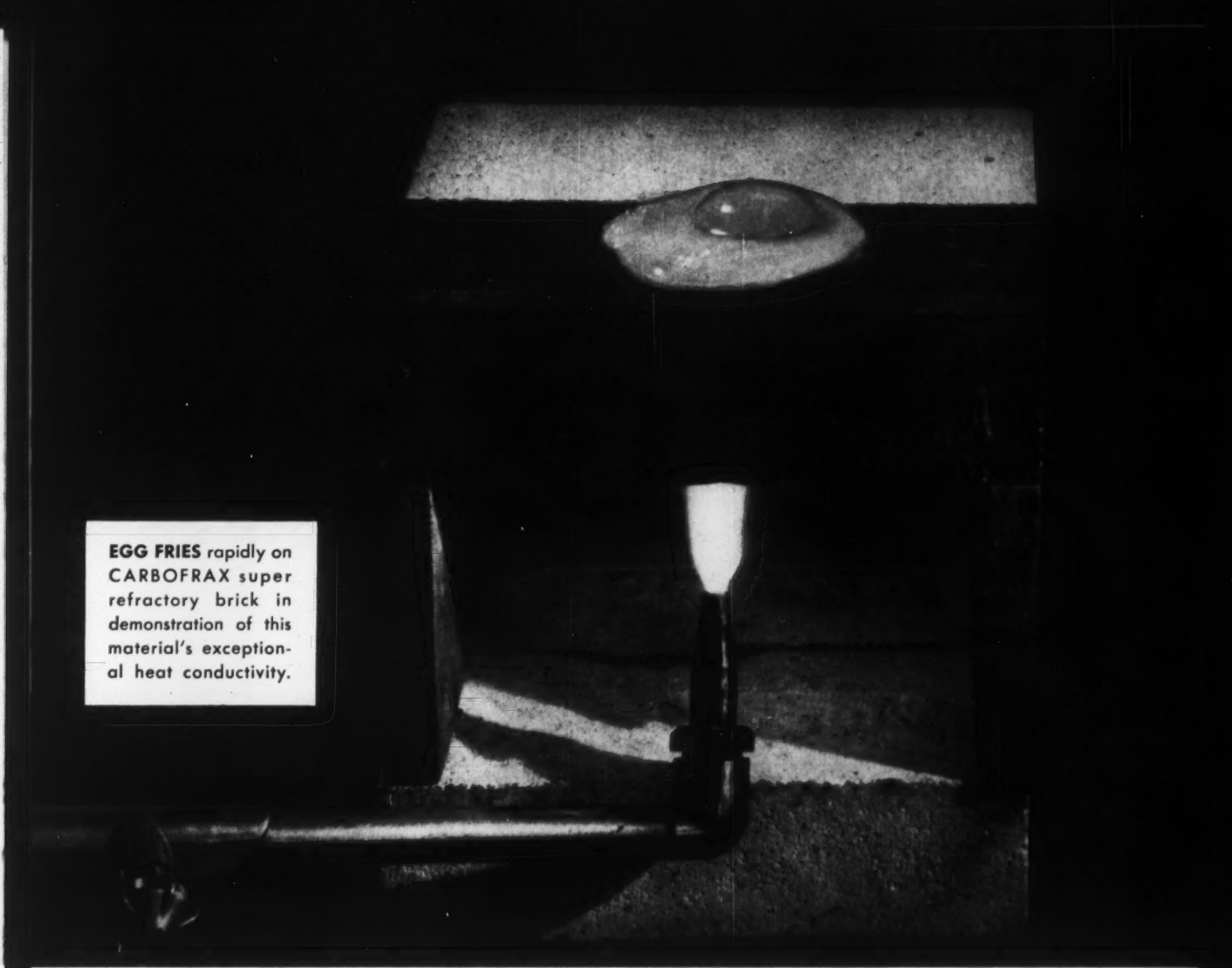

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Refractories for high **heat conductivity**

At 2200°F, CARBOFRAX® silicon carbide brick transmit 109 BTU/hr., sq. ft. and °F/in. of thickness. That is roughly 11 times the heat conductivity of fireclay and about 70% that of chrome-nickel steels. This conductivity becomes particularly valuable at the higher temperatures which these refractories alone can withstand (up to 3000°F without deformation; under certain conditions even higher). For example, there is increasing use of CARBOFRAX radiant tubes, muffles, retorts, and other structures which may operate at temperatures beyond the limitations of metals.

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frame of reference

The chart below is a simplified representation of 11 different staff member fields at Sandia Corporation. You might call it an occupational frame of reference, within which are located the many activities involved in our work—design and development of nuclear weapons for the Atomic Energy Commission. In each of the 11 fields, challenging positions are available for qualified engineers and scientists at all degree and experience levels.

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Applied Research			
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SANDIA CORPORATION

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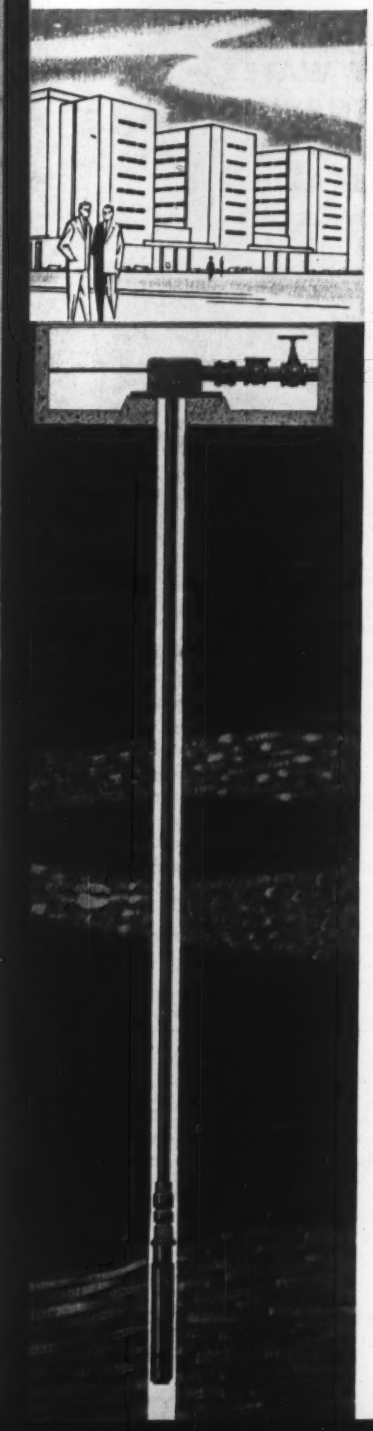
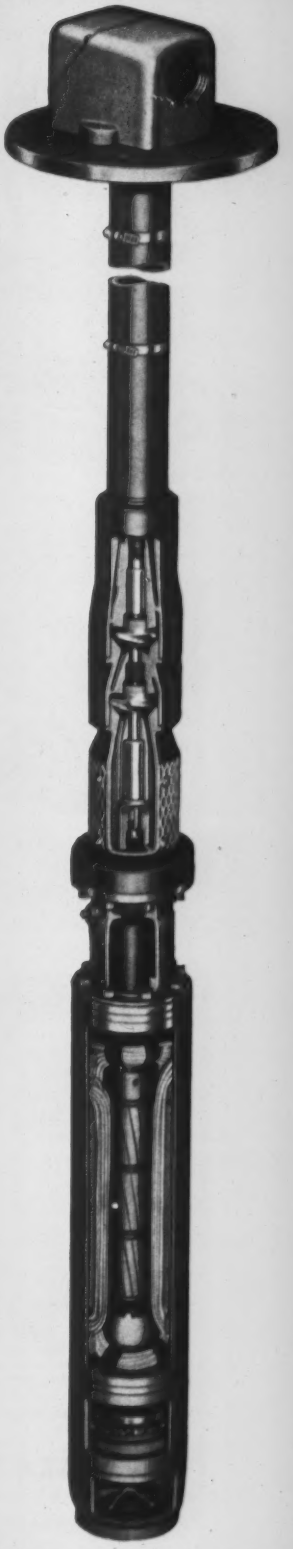
Now you can bury your pumping problems





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Fairbanks-Morse submersible pumps permit well location anywhere that a well can be drilled. No unsightly installations, no costly pump housing. Nothing—absolutely nothing—need show above ground. These pumps submerged in the well below water level are practically soundless and require no line shafts, packing boxes or lubrication devices. Hence, wearing parts needing maintenance are reduced to a minimum. A single moving assembly does all the work.

Installation is faster and more economical. The Fairbanks-Morse motor, with lifetime Copperspun rotor cooled by water and lubricated by water, gives full motor output. The well-known Fairbanks-Morse or Pomona pump bowls are combined with these wet stator motors to produce unbeatable pumping units covering a wide range of requirements as to volume, pressure, and setting depth.

For industry or community service you can place your water service trust in the F-M submersible. Contact your Fairbanks-Morse Sales Engineer and ask him for Bulletin 6910 on this time-proved submersible pump, or write today to Fairbanks, Morse & Co., Dept. ME-8, 600 S. Michigan Avenue, Chicago 5, Illinois.

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PUTTING THE BRAKES ON A 632 MPH SLED!

Being strapped in for another record-shattering run is Colonel John Stapp, USAF, who, through piloting of the Northrop sled, has become the "fastest land-based man on earth."

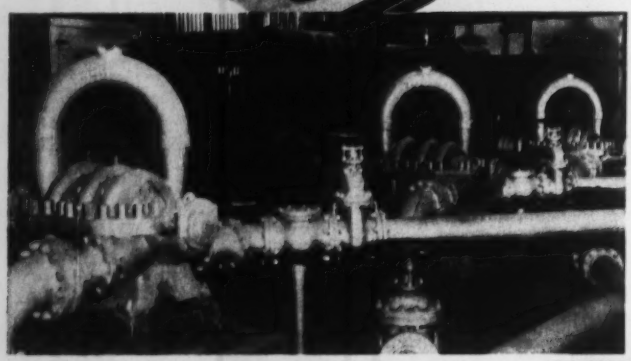
Air Force technicians make final settings on six rockets which propel sled.

PEERLESS PUMPS SUPPLY WATER FOR STOPPING NORTHROP'S ACCELERATION TESTING SLED

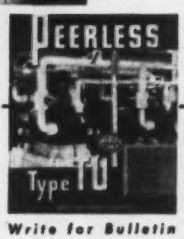
How violent are the reactions of a man to severe, blinding acceleration? Does he black out, maintain equilibrium, lose senses? And what happens under sudden, screeching deceleration? How many G's can he be expected to withstand and still function?

Answers to these and many other questions in the fields of aviation, physics, and environmental physiology are being found with each successive test by Colonel John Stapp, USAF, and his flying sled. Truly a "rocket on rails," this contribution is providing invaluable data for science by duplicating the stresses of flight on man, *on the ground.*

A highly important segment of this sled project, namely that of braking the vehicle, is dependent on the reliability of the pumps that supply the unique water-trap braking system. Performance of this vital task has been delegated to four Peerless Type TUT 3-stage centrifugal pumps. Here is one more instance where good design, sound construction and skillful application add up to a quality Peerless installation. Whatever the use, no matter what the requirements, there is a Peerless pump that will do the job and do it well. *For remember, Peerless stands for performance.*



Shown above are three of the four 4" TUT-14 3-stage Peerless centrifugal pumps that form the water-supplying unit. Running at 1750 RPM, these pumps move 500 GPM to the braking system which is 500 feet away from the pump installation.



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ME

Servo-Operated Voltage Regulator

500 Amperes Peak
50 Amps Continuous

G-R Regulator incorporated in motor-test equipment at General Electric Appliance Motor Department, Dekalb, Illinois.

The excellent transient overload characteristic of the G-R Automatic Line-Voltage Regulator ideally suits it for loads with high peak currents.

The short-period overload rating — *up to ten times the steady-state rating* — makes this electro-mechanical device particularly useful in motor testing where starting currents many times normal running currents are encountered. Fast response and high accuracy make for accurate measurements of motor output torque and input current at various line voltages.

This Regulator's output impedance is essentially zero for steady-state conditions and less than 0.02 ohm during load transients. Consequently, the regulator transient at double load is only about 2% and this is corrected within 0.2 second, resulting in an almost ideal voltage source.

The application of proportional-control servomechanisms to voltage-regulator design has produced a rugged device offering many operating advantages for industrial or laboratory application. High accuracy, excellent transient response, large power-handling capacity, freedom from power-factor restrictions, and very low cost per KVA rating are all to be found in this one compact unit.

Two-percent change in 60c voltage input (left oscillogram) is corrected in 12c or 0.2 sec (right) by G-R Line-Voltage Regulator.

Fluctuating line voltages as small as 0.25% are corrected by a buck-or-boost voltage supplied from a motor-driven Variac. There is no chattering, there can be absolutely no introduction of distortion, and there are no power-factor restrictions as in saturable-reactor regulators.

Type 1570-A
Automatic Line-Voltage Regulator

115v or 230v models for table top or relay rack, **$480**

Militarized Type 1570-ALS15 unit, **$825**

3 units may be used to regulate each phase of a 3-phase circuit

- Accuracy is ±0.25%, independent of load
- 6 KVA load rating
- Speed of correction is 10v per second
- Output voltage is adjustable ±10%
- Input voltage range is ±10% (or ±20%*)
- Efficiency is 98%
- Full accuracy at any load power factor
- Weighs considerably less per KVA than other types
- Costs less per KVA

*±20% range must be specified on order; speed of correction is doubled, power capacity and accuracy are halved.

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Jules Verne's "Nautilus" In 1870 one of the greatest science-fiction writers dipped into his imagination and created a fantastic submarine for his classic "Twenty Thousand Leagues Under The Sea". This unbelievable vessel was shaped like a cigar, 232 feet long, and could cruise at terrific speed to all parts of the world. It was called the "Nautilus".

Engineers! Turning Fancy Into Fact Is A Westinghouse Tradition

85 years later, Westinghouse actually turned this thrilling fancy into fact. On January 17, 1955 a modern "Nautilus" cruised down Connecticut's Thames River into Long Island Sound to start her sea trials. Powered by a history making nuclear engine, its exploits surpassed even the creation of Jules Verne's prolific imagination. For the first time controlled nuclear fission had successfully provided the motive power for a vehicle or vessel.

ENGINEERS — ***Westinghouse is now engaged in building the world's first atomic powered fleet. If your background includes pump, valve, or arrangments experience, join our atomic team in this historic undertaking.***

U.S.S. Nautilus

Powered by the "S2W" Atomic Engine, created and built by Westinghouse.

Submit your resume to:
Mr. John D. Batey

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First in Atomic Power

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And all make air preheating with a Ljungstrom more economical, less troublesome. The Ljungstrom offers these refinements:

- The welded steel rotor is strong enough to support the heating elements without strain, yet flexible enough to withstand extreme temperature variations.
- An inspection port and strategically located access doors reveal any maintenance needs and make replacement work routine.
- A mass flow soot blower is installed as original equipment at the cold end where deposits are most apt to accumulate.
- The hot end heating surface is made from open hearth steel sheet and the cold end from heavier gauge, low-alloy corrosion-resisting material because corrosion is normally confined to the cold end.

The Air Preheater Corp. is constantly working to improve Ljungstrom heating surfaces, seals, bearings, and other structural details. And, in general, these improvements can be applied to existing units with only minor changes and at nominal cost. Another reason why seven out of ten air preheating installations are Ljungstrom. For the full story on how the Ljungstrom design and construction can cut your fuel costs, increase plant efficiency, write for our 38-page manual.

The Air Preheater Corporation, 60 EAST 42ND STREET, NEW YORK 17, N. Y.

CRAWFORD H. GREENEWALT

"$22,800,000 Invested in U.S. Savings Bonds During First Year of Thrift Plan . . ."

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CRAWFORD H. GREENEWALT,
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Large or small, every company can give their employees the advantages of the Payroll Savings Plan. Installation of the Plan is simplicity itself. A Treasury representative will give you all the assistance you need to introduce the Plan or build enrollment in an existing Plan. Write: Savings Bonds Division, U.S. Treasury Department, Washington, D. C. for complete information.

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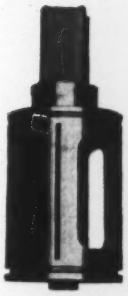

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ALL TYPES OF PLUG VALVES

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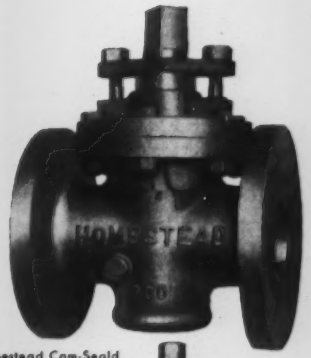
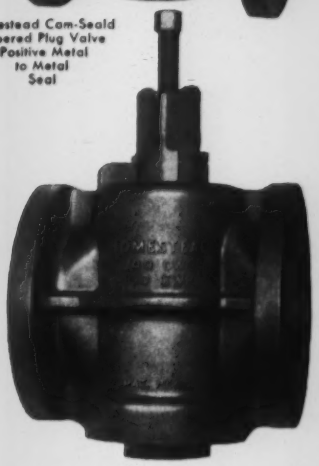


Homestead Cam-Seald Tapered Plug Valve Positive Metal to Metal Seal



Homestead Lubricated Plug Valve High Pressure Chemical Seal

Name the type of valve you need in the metal or alloy you require with the port opening you want—and we can furnish it. Or if you have a valve problem that defies solution, write us, naming the fluid, concentration, temperature, pressure, valve size, function and frequency of operation. We will be happy to recommend the best and most economical valve for your service conditions.

For complete information on Homestead Plug Valves

Homestead Lever-Seald Tapered Plug Valve Positive Seal Without Lubrication

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Please send me information on the following Homestead Plug Valves:

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Company_____

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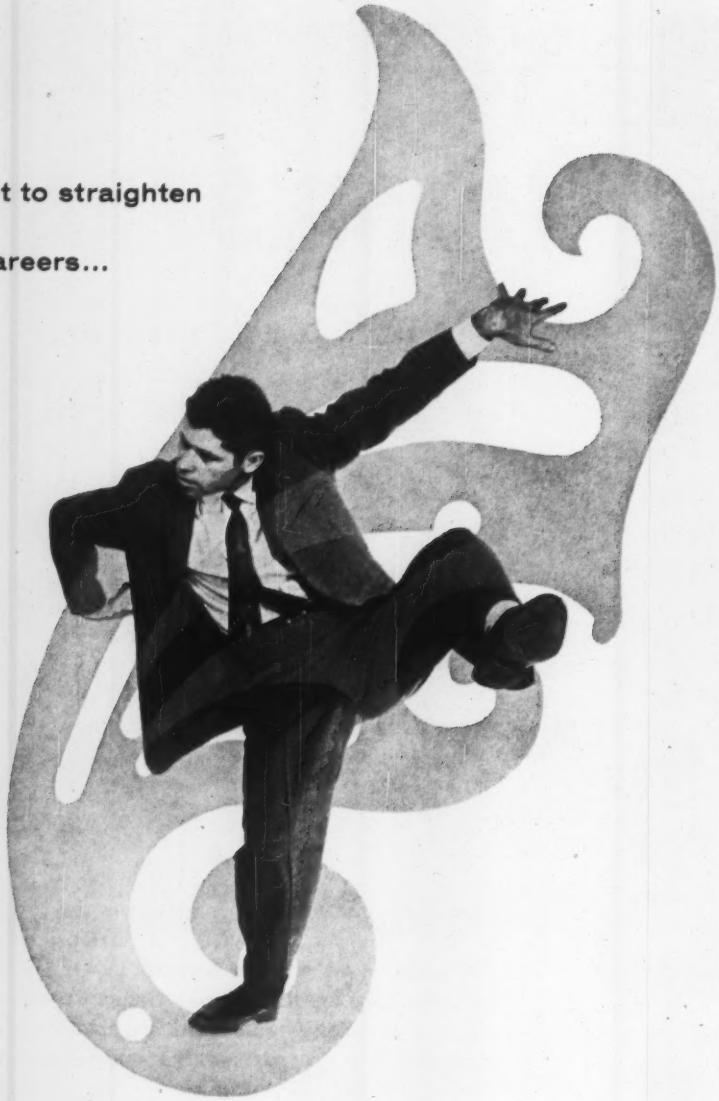

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Spurgeon Automation Unit on the test floor of the Spurgeon Company at Van Dyke, Mich. Note the vital points where Clevelands are installed—a small unit (20AT) driving the feed mechanism and two 70ND units, one at each end of the elevator lift.

Spurgeon automation unit employs three CLEVELANDS

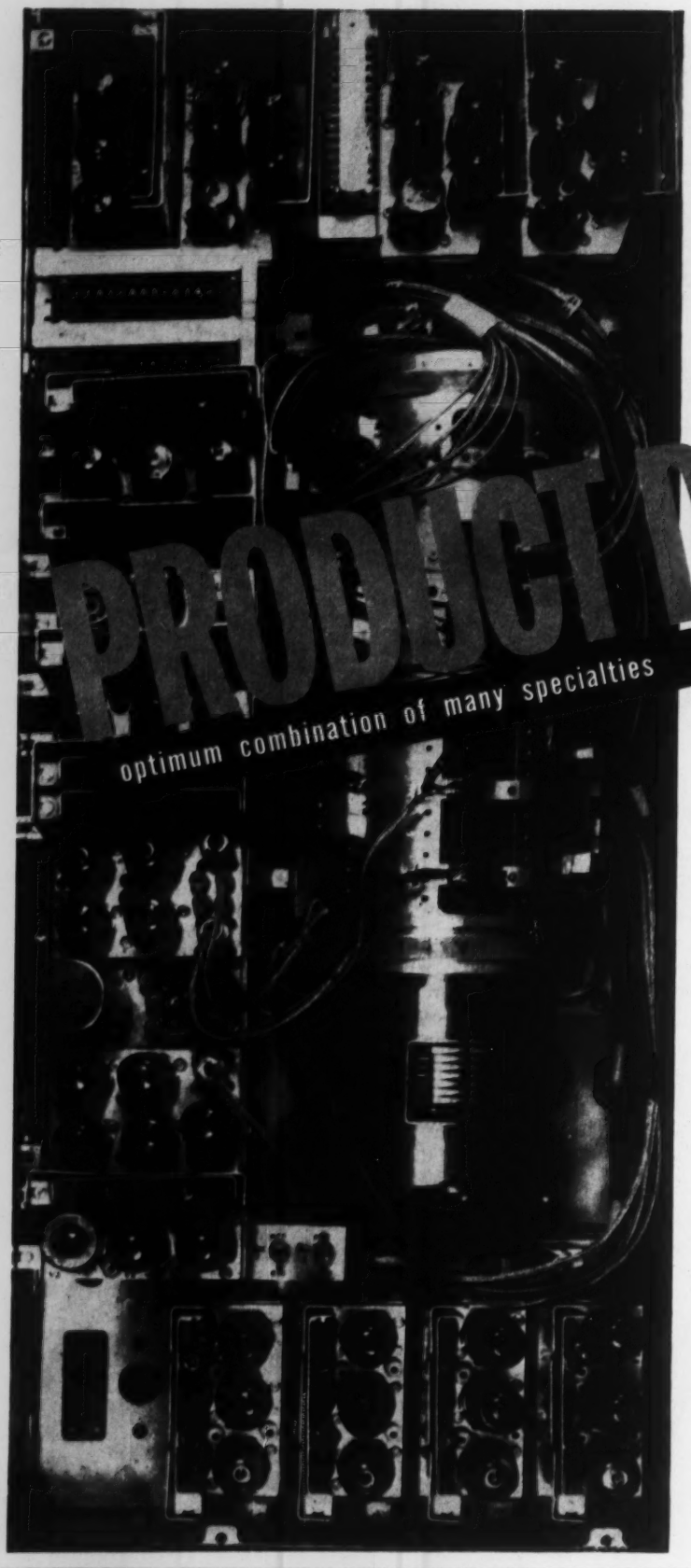
IN a Detroit automotive plant, three Spurgeon units automatically elevate, transfer and feed steel bars into bar cut-off machines. Top production is gained and hours of man power and money are saved by automation.

Three Cleveland Worm Gear Speed Reducers are employed on each Spurgeon unit: Two vertical reducers on the mechanical drive that operates the elevator; a third Cleveland on the "V" Roll Conveyor pushes the rods into the bar cut-off machine.

Automation and Cleveland Worm Gear Speed Reducers go hand-in-hand. Precision matching of case-hardened steel worms to nickel-bronze gears insures 100% dependability. And, the compact, right-angle Cleveland design saves space and makes installation easy.

Find out what Cleveland can do for your operations before you buy. Catalog 400 gives the story. The Cleveland Worm and Gear Co., 3264 E. 80th St., Cleveland 4, O.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.



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MAINTAINABILITY, HEAT TRANSFER,
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Electronic Product Design at Hughes is the optimum of many and varied specialties. This expert coordination of specialists has resulted in the solution of complex packaging problems, including the airborne Electronic Armament System and the Falcon guided missile.

New projects soon to be underway concern developing practical solutions to the theoretical and actual problems associated with Electronic Product Design.

These Hughes projects have both military and commercial application, assuring you of an unlimited future. Engineering positions to be filled include the following: Reliability, Component Application, Electromechanical Development, Miniaturization and Packaging, Chemical and Metallurgical Applications and Precision Electronics Test-Supervisor.

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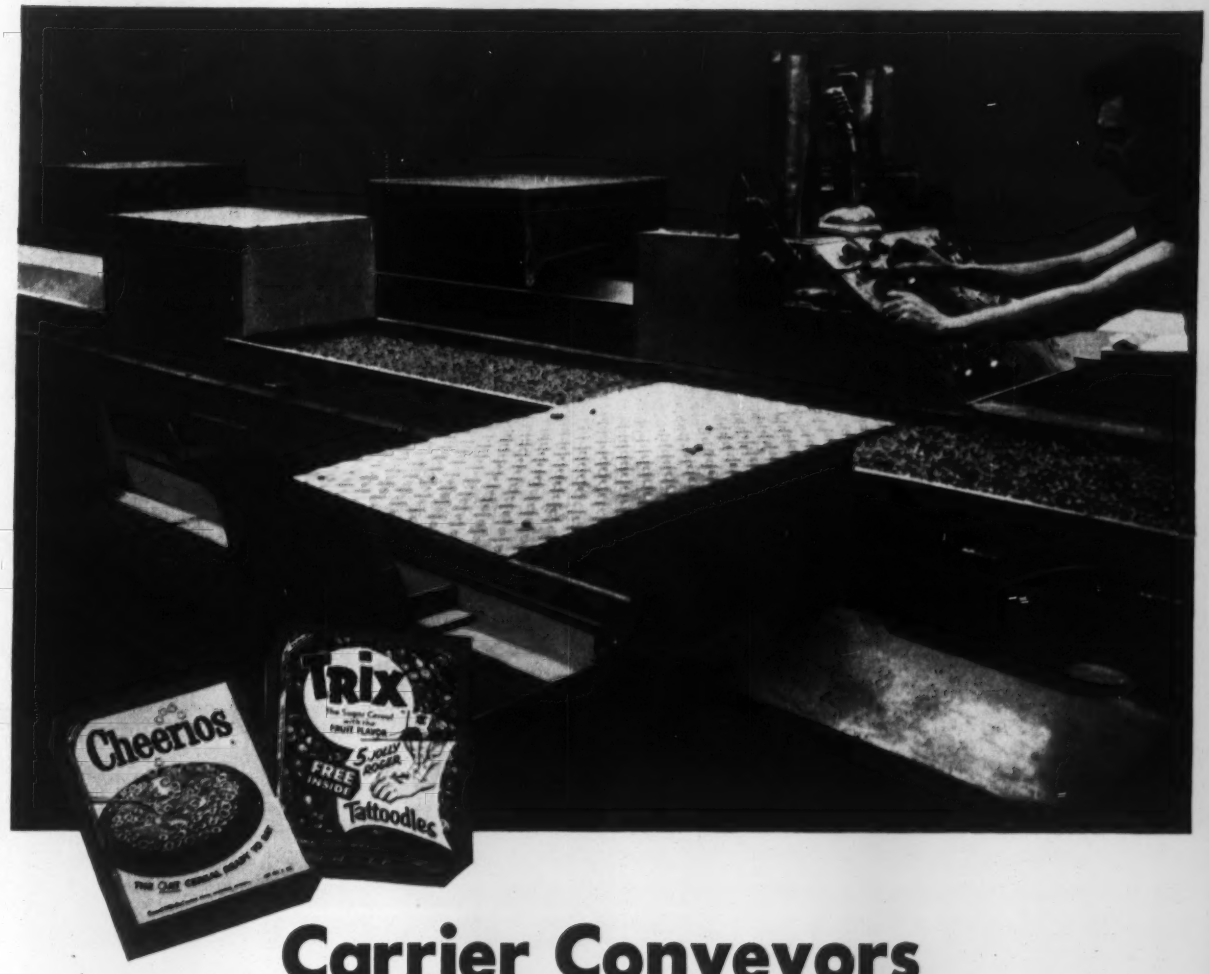


Carrier Conveyors go for Cheerios and TRIX!

490′ SYSTEM GRADES, SCALPS, CONVEYS!

In 1955 when General Mills decided to produce Cheerios and Trix in their Toledo plant, the choice of conveying and processing equipment was all-important.

Because of the cereals' fragile nature, a screw-conveyor system was ruled out. An endless-belt system was also ruled out because of maintenance and cleaning requirements — and also because a special scalping process would have to be devised.

Eight Carrier Natural-Frequency Conveyors were finally chosen — a four conveyor system, each, for Cheerios and Trix. Each system grades and scalps the cereals, *as it conveys them.* All told, the Toledo plant has 490′ of covered Carrier Conveyors, handling all of their daily cereal production, with an absolute minimum of maintenance!

Commenting on the Carrier equipment, Plant Engineer Robert Braeden said:

> **"These conveyors do all that we expected of them and require very little maintenance . . . I don't know of any other unit on the market today that could do a better job."**

Write today for literature describing the complete line of Carrier Natural-Frequency Vibrating Equipment. Address: Carrier Conveyor Corporation, 232-A North Jackson Street, Louisville 2, Kentucky.

CARRIER

~~**NATURAL-FREQUENCY**~~

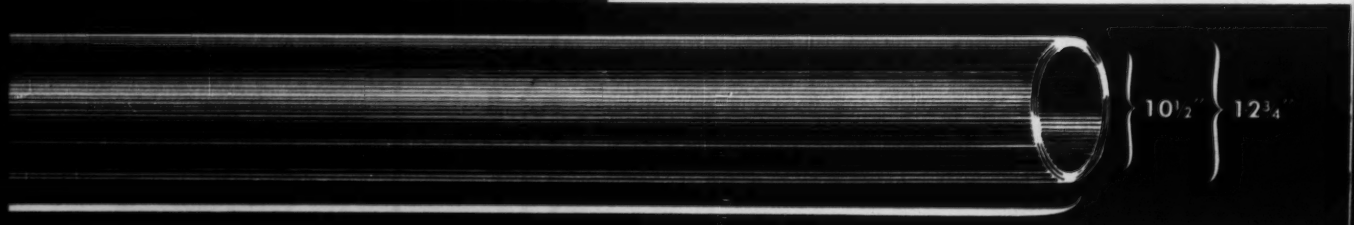
CONVEYORS

3 PROBLEMS
each different

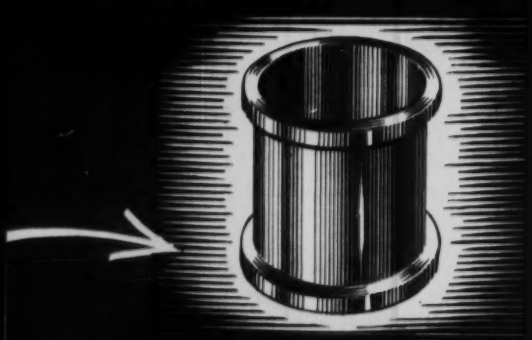
1 SOLUTION...
stainless steel
Centrifugal Castings

Heavy Wall stainless steel pipe, centrifuge bowls, hollow billets for finely drawn hypodermic needle tubing . . .

These are among the many end uses for metal mold centrifugally cast cylindrical shapes. They are typical of the exacting, difficult service conditions to which this product is subjected. All three examples shown demonstrate the fundamental versatility of this manufacturing process—unequaled product soundness—from hypodermic needle stock subjected to the repeated stresses of cold reduction, to the centrifuge bowl spun



at 1800 RPM, to the petrochemical plant reactor piping that must pass hydrostatic pressure tests equal to 90% of the Yield Strength of the metal. These are the proving grounds of quality—of the ability to meet even the most exacting of product specifications.



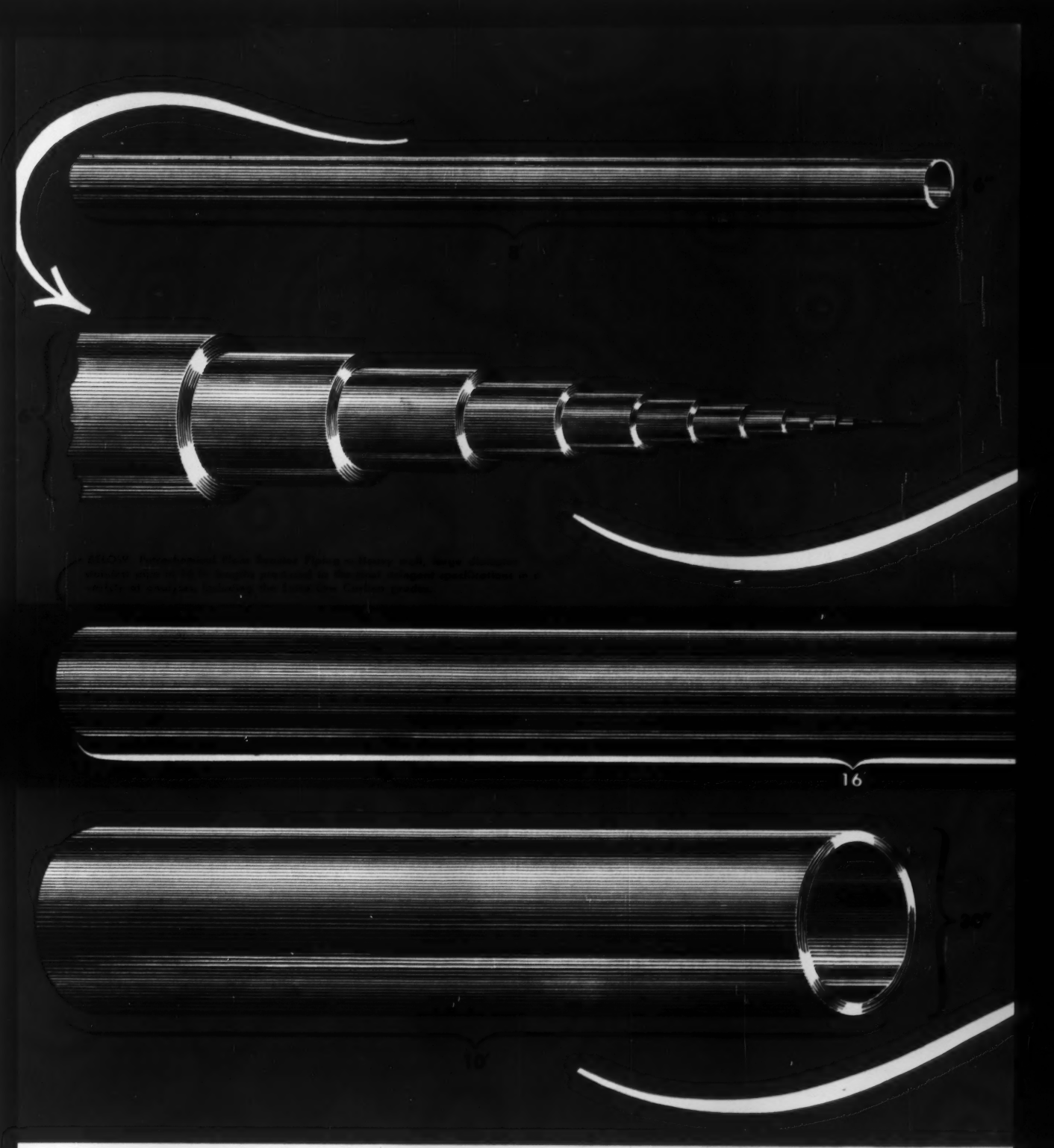
We welcome your inquiries. For descriptive literature on the versatile metal mold process, write to United States Pipe and Foundry Company, Steel and Tubes Division, Burlington, N. J.

Study these advantages for your cylindrically-shaped products

- Reduced processing time and increased production.
- Design of parts to suit the specific job requirements by selecting the correct alloy — not the next best available alternate.
- Conservation of expensive metals and alloys — especially on tubular parts now produced from solid sections.

SIZE RANGE AND COMPOSITION FLEXIBILITY

Outside Diameter—6" to 50"
Wall Thickness—⅜" and up
Length—Up to 16'
Types of Stainless—All Standard AISI and ACI grades of ferritic and austenitic stainless, including No. 20 Alloy, 17-4 P H, 17-7 P H and E.L.C. grades.



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Individual Initiative in Research and Engineering

The Jet Propulsion Laboratory has brought together an outstanding staff of engineers of exceptional talent and ability. Working individually within the group these men now comprise a highly progressive and productive entity.

A recent survey of this staff indicated that the most important reason for their preference of JPL as a work center is the high degree of responsibility and freedom given the individual to pursue his own assignments. The intriguing nature of the work, challenging problems, professional association, fine residential location, pay scales and opportunities for career development were also important considerations.

This appreciation, from within, of the Laboratory's principle of recognizing ability and talent and allowing it to operate with freedom and confidence under its own initiative is a gratifying tribute in itself.

Working for the U.S. Army on a research and development contract with many ramifications, JPL has broad interests and constantly searches for new approaches to modern technical problems. This provides exceptional career opportunities for those qualified individuals who are interested.

Career Opportunities Now Open in These Fields

ELECTRONICS · PHYSICS · AERODYNAMICS · MATHEMATICS

MECHANICAL ENGINEERING · CHEMICAL ENGINEERING

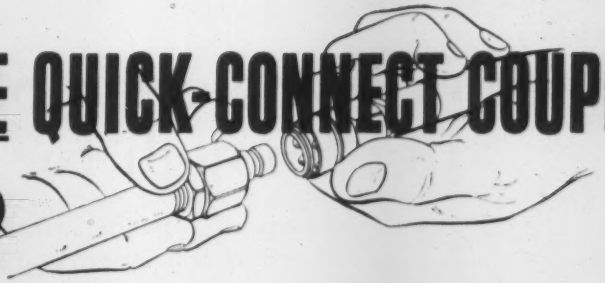
jpl

JET PROPULSION LABORATORY

California Institute of Technology

PASADENA · CALIFORNIA

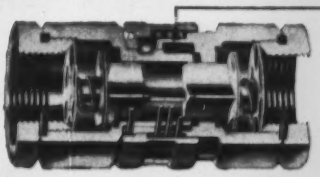
WHICH SNAP-TITE QUICK-CONNECT COUPLING IS BEST FOR YOU?



SNAP-TITE "H" COUPLING . . . . . FOR HIGH PRESSURE APPLICATIONS

FOR HYDRAULIC OR AIR

"H" Coupling for high strength, higher efficiency, high-resistance to heavy line surge. Sizes: ⅛" thru 12". Bulletin No. 240

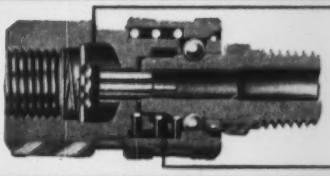


Exclusive U-packer gives a positive seal without compression set because of rubber distortion. Line pressure inside the U-packer keeps it open and forced against its metal backing—the higher the pressure, the tighter the seal.

SNAP-TITE HI-FLOW COUPLING . . . FOR LOW PRESSURE APPLICATIONS

FOR AIR AND FLUIDS UP TO 150 p.s.i.

Hi-Flow is recommended to connect small air tools to plant air system, and for low pressure fluid transfer in small lines. Sizes: ⅛" thru ¾". Bulletin No. 230

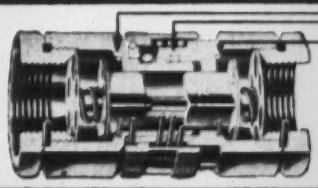


Bonded valve washer
(pat. pending on valve construction)

Exclusive U-packer

SNAP-TITE "HK" COUPLING . . . . . FOR HARD TO HANDLE FLUIDS

FOR FUMING ACIDS, ALKALIES, SOLVENTS, AND HIGH PRESSURE STEAM . . . "HK" is the only coupling now on the market for fluid temperatures from —100° F to +500° F . . . and for live steam up to 460° F. Its seals are made of Teflon for which there is no known solvent. Sizes: ½" thru 3". Bulletin No. 270



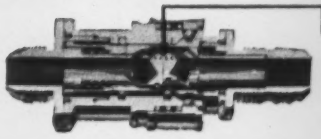
Teflon Valve Seal

Teflon Nipple Seal

Teflon Valve Seal

SNAP-TITE NO-SPILL COUPLING . . . FOR MINIMUM AIR INCLUSION

FOR AIRCRAFT, MISSILE HYDRAULIC, FUEL SYSTEMS which cannot stand air in the lines, and for transmitting fluids which *must not spill*, the Snap-Tite no-spill coupling is recommended. Bulletin No. 280

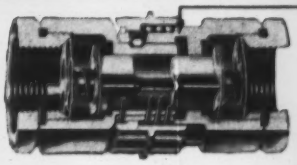


Flush valves prevent spillage, air inclusion. Snap-Tite will engineer special variations to your requirements.

SNAP-TITE "E" COUPLING . . . . . FOR VACUUM and VERY LOW PRESSURE

FOR VACUUM SYSTEMS IN THE MICRON RANGE

"E" Coupling performs in the *micron* range in the smaller sizes both connected and disconnected. Recommended, too, for gravity flow . . . U.L. approved for LP Gas. Sizes: ⅛" thru 12". Bulletin No. 250



Nipple seals in coupler by depressing the lip of the E packer and slightly compressing the body of the packer. This new E-packer gives positive seal under high-pressure, low-pressure, and vacuum.

Snap-Tite Couplings are available plain, (without valves), and with either single or double shut-off. Couplings normally furnished in alloy steel, but all (except hi-flow) are also available in brass, aluminum, or stainless steel with a variety of finishes.

SNAP-TITE, INC., UNION CITY 4, PA.

Snap-Tite

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS

One in a series.

How to Select a Steam Trap Big Enough for the Job

Adequate capacity safety factors are essential to operating efficiency

As promised to you in a previous Armstrong trap advertisement in this publication, here is some helpful information on steam trap safety factors.

First, the definition. A trap safety factor is simply the ratio between actual continuous discharge capacity of the trap and normal condensate load. If the load is 500 lb/hr and the trap actually will discharge at the rate of 1000 lb/hr, the safety factor is said to be 2 to 1, and so on.

Why a Safety Factor?

You are not going to get maximum heat transfer efficiency from any steam heated unit unless your traps are sized with a generous excess of capacity over the normal condensate load.

Remember that trap capacity is given in terms of *continuous* discharge of condensate at a given pressure differential. If you don't employ an adequate safety factor, you make no provision for these requirements or conditions:

1. ***Venting of gas,*** O_2 and CO_2, would be impossible if a trap should discharge a full stream of water continuously.

2. ***Peak loads*** would back up condensate in the line or unit if the trap were sized for average load.

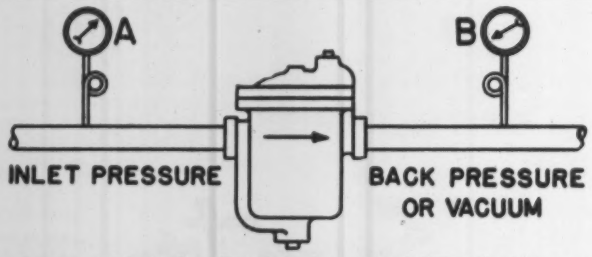
3. ***Reduction in pressure differential*** across the trap orifice would reduce capacity below requirements. If steam pressure drops below normal, trap capacity is lowered more than condensing rate. An increase in back pressure for any reason cuts trap capacity. And, pressure differentials often drop substantially during warming-up periods.

4. ***"Group" trapping.*** Very occasionally it is impractical to use an individual trap on each coil or condensing unit. Here, a generously oversized trap helps prevent backup of condensate or air from one unit to another. The frequent opening of a big trap valve "pumps" non-condensibles and condensate to the drain header.

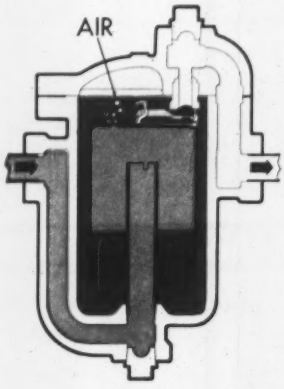
What Safety Factor?

Fortunately, it isn't necessary to calculate safety factors. Experience is the best guide and the benefit of experience with tens of thousands of successful installations is available to you. The following table is taken from the Armstrong Steam Trap Book.

Page	Equipment Drained	Safety Factors
24	Purifiers and Separators	2 or 3 to 1
25	Steam Mains or Headers	2 or 3 to 1
26	Steam Heating Pipes	2 to 1 up to 6 to 1
29	Unit Heaters	3 to 1
30	Submerged Coils	2, 3 or 4 to 1
32	Cylinder Dryers	4 to 1 up to 10 to 1



Pressure differential affects trap capacity. If "B" is back pressure, subtract from "A"; if "B" is vacuum, add to "A". Safety factors compensate for drops in pressure differential.



Traps vent air. This requires a trap capacity safety factor.

The page numbers listed contain completely reliable data for any trapping job.

CAUTION. The safety factors recommended in The Armstrong Steam Trap Book will have to be increased by an unknown factor for trap capacity ratings based on cold water tests, orifice tests or slide rule calculations. Armstrong trap steam temperature condensate capacity ratings are based on actual operating conditions which take into account such capacity-reducing factors as pipe friction and the choking effect of flash steam.

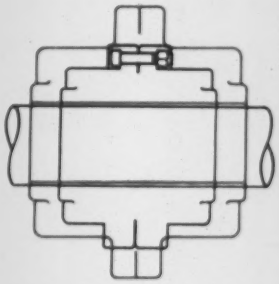
If you'd like to have a copy of the 44-page Steam Trap Book, just call your local Armstrong Representative, or write the factory. There is no obligation.

Armstrong Machine Works
8944 Maple Street
Three Rivers, Michigan

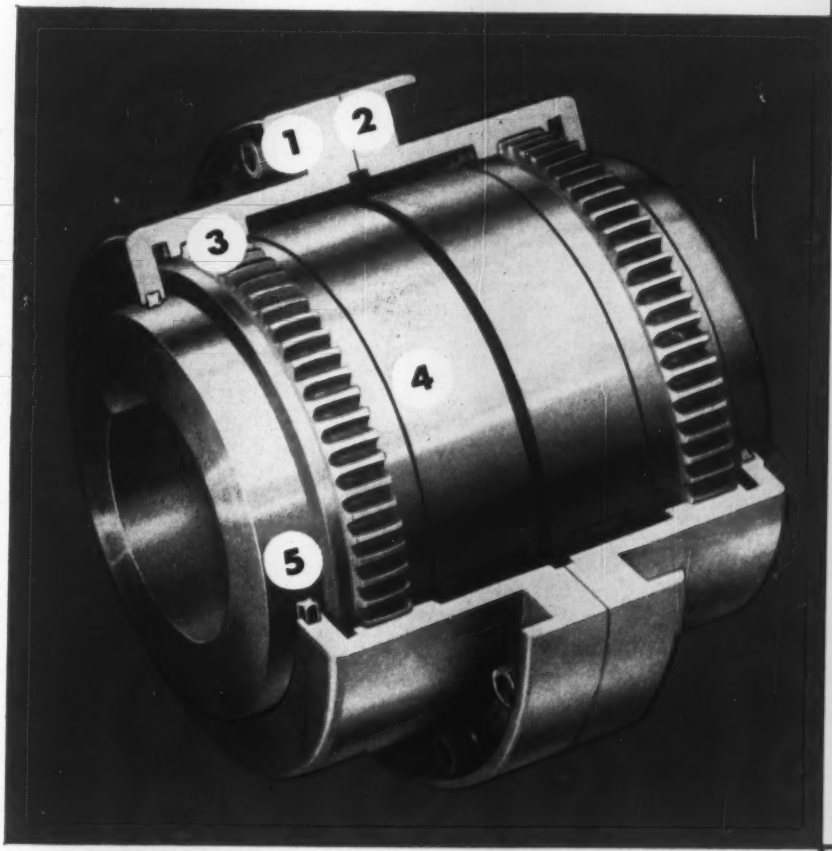
ARMSTRONG STEAM TRAPS

Compactness - -

it's the big difference in geared flexible couplings



Link-Belt geared couplings (black) are smaller, lighter, yet highly capable—provide dependable performance plus savings in space and cost.



These features assure coupling reliability:

1. **SOCKET HEAD FLANGE BOLTS** of hardened steel with ground body securely join housing halves. Locknuts prevent loosening in operation.
2. **FIBER GASKET** fits tightly between flanges. Lubricant can't escape.
3. **PRECISION-CUT** gear teeth have controlled clearance to allow for normal misalignment—minimum backlash.
4. **ALL-STEEL CONSTRUCTION** with properly proportioned parts assures sturdiness, long life operation.
5. **QUAD-RING SEALS** are exceptionally effective in retaining the lubricant. Gearing is always submerged in oil, assuring long, trouble-free operation.

That's why LINK-BELT geared flexible couplings transmit more hp per coupling dollar

COMPACTNESS and high load capacity make Link-Belt geared flexible couplings your best answer for economical power transmission. Size for size, they will accommodate larger, more powerful shafts than other flexible couplings.

These couplings are all-steel and accurately machined for dependability and long life. Hardened flange bolts are ground for close fit. Socket type bolt heads require less of the coupling diameter to be used in the flange—more is available for larger gears and larger shafts.

Compact and rugged—these couplings offer exceptional durability to cope with shock, pulsation, reversing loads and misalignment. For facts, contact your Link-Belt office or authorized stock-carrying distributor. Or write for Folder 2775.

LINK-BELT

GEARED FLEXIBLE COUPLINGS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarboro - (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World.

14.488

B-58 CONVAIR
U.S. AIR FORCE
506
B-58
HERBERT W. HINCKLEY,
Assistant Chief Engineer, has more than 28 years experience in aeronautics, 24 of them with Convair. He is responsible for directing the activities of the Product Design, Testing, Project and Service Engineering and Structure Sections at CONVAIR-FORT WORTH.

"Engineers . . . here's how we brought the B-58 from concept to reality in record time!"

"CONVAIR-FORT WORTH was first to develop a modern bomber under the new Weapons System Management concept. This enabled us to save more than two years' time in bringing the supersonic B-58 Hustler from concept to reality.

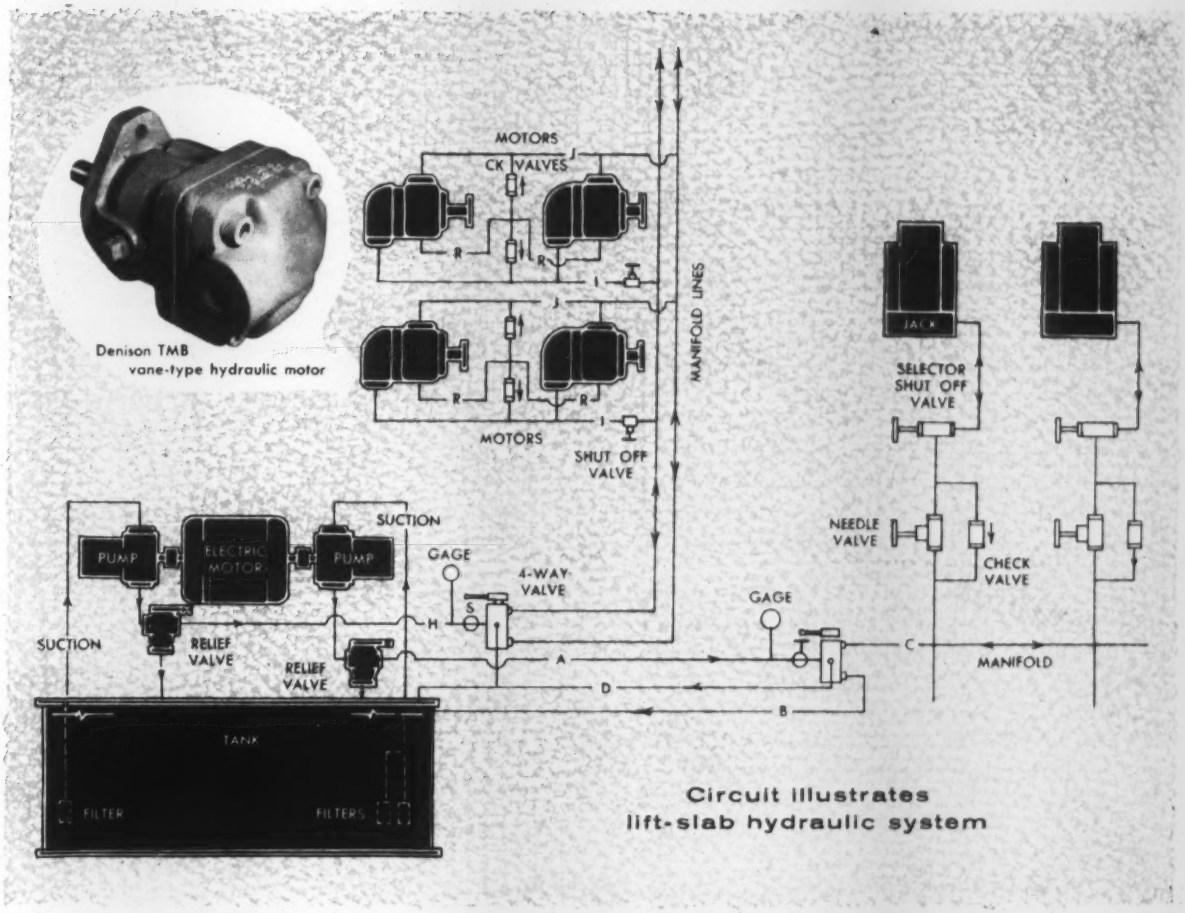
"As Weapons System Manager, CONVAIR-FORT WORTH cooperated with thousands of other engineers in electronics and related fields. This close working partnership helped greatly to accelerate the design and procurement of every major piece of mechanical and electronic equipment on the B-58.

"We integrated design requirements for this equipment with those of the aircraft, and design of both with the necessary production requirements — materials, tooling, methods and plant facilities. *This carefully controlled, highly integrated program brought the B-58 to the flight test stage in record time.*"

Many of America's most capable engineers, working on the B-58 project, have demonstrated what we mean when we say, "Your future is at CONVAIR-*FORT WORTH.*" If you are a qualified engineer with creative talents and vision, we need you NOW! With more than 50 Air Force contracts, we can offer you long-range security and diversity of activity.

You'll enjoy living in an exceptionally friendly community with countless educational, cultural and recreational facilities — with adequate housing in all price ranges only minutes away. No state sales or income tax. For greater career opportunity — for your future's sake — write today to: Mr. H. A. Bodley, Engineering Personnel.

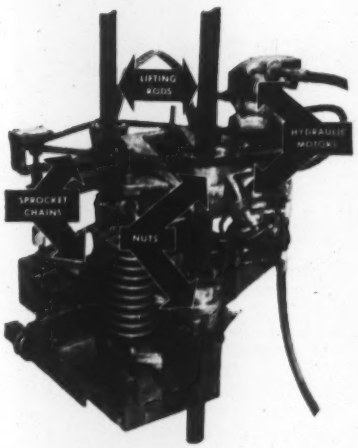
CONVAIR
FORT WORTH
FORT WORTH, TEXAS
CONVAIR IS A DIVISION OF GENERAL DYNAMICS CORPORATION



Circuit illustrates lift-slab hydraulic system

Helping to raise the roof

...another application for Denison hydraulic power



Lifting jack used in this operation can raise slabs 4 feet per hour. Nuts are turned by sprocket chains actuated by Denison hydraulic motors.

Since the first lift-slab building was erected in 1950, the interest and demand for this method of construction has increased to such an extent that lifting 500-ton slabs of concrete into the air hydraulically is now an everyday occurrence.

The lifting equipment consists of a series of hydraulic jacks operated from a console. Two Denison hydraulic motors on each lifting jack are used to actuate sprocket chains which turn nuts on threaded lifting rods and follow up the lifting action of the jacks.

Dependable, easily controlled hydraulic power assures a virtually foolproof operation.

This unique application illustrates one of many potential uses for hydraulic power. When designing any type of equipment or machinery, consult a hydraulic specialist. Write Denison Engineering Division, American Brake Shoe Co., 1174 Dublin Road, Columbus 16, Ohio.

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HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

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How to make the most of your engineering career

ONE OF A SERIES

go where engineers get personal recognition

You'll get ahead faster in a company in which frequent merit reviews assure you personal recognition. This is the kind of company that's really interested in its engineers—and interested in recognizing, and rewarding, individual contributions.

This, incidentally, is exactly the kind of attitude you'll find at Boeing. Here you'll get regular merit reviews, each one an opportunity for individual recognition, advancement and increased income. In addition, you can move ahead at Boeing any time between reviews. Boeing is expanding steadily, which means constant openings for advancement. Boeing is actively interested in moving engineers up to positions of higher pay and responsibility as fast as their abilities warrant.

At Boeing you'll be working in small integrated teams, on some of the most exciting, long-range projects in the country—on top-secret chemical fueled aircraft, on the BOMARC supersonic guided missile weapons system, on global jet bombers and jet tanker-transports, and on the Boeing 707, America's *first* jet airliner.

Boeing's diversified operations are located in three sections of the country. In each you'll find excellent housing and schools, and recreational facilities for the whole family. Boeing offers scientists and mathematicians, and engineers of ALL categories, high salaries, career stability, insurance and retirement benefits, and a company-paid graduate study program.

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Aviation leadership since 1916

Make the most of your engineering career. Fill in the coupon and mail it—today!

JOHN C. SANDERS, Staff Engineer — Personnel Administrator — Boeing Airplane Co., Dept. F-66, Seattle 24, Wash.

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Mail this coupon to the address above from which you desire further information about the advantages of a career with Boeing.

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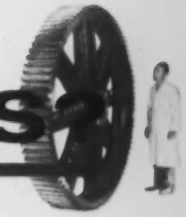
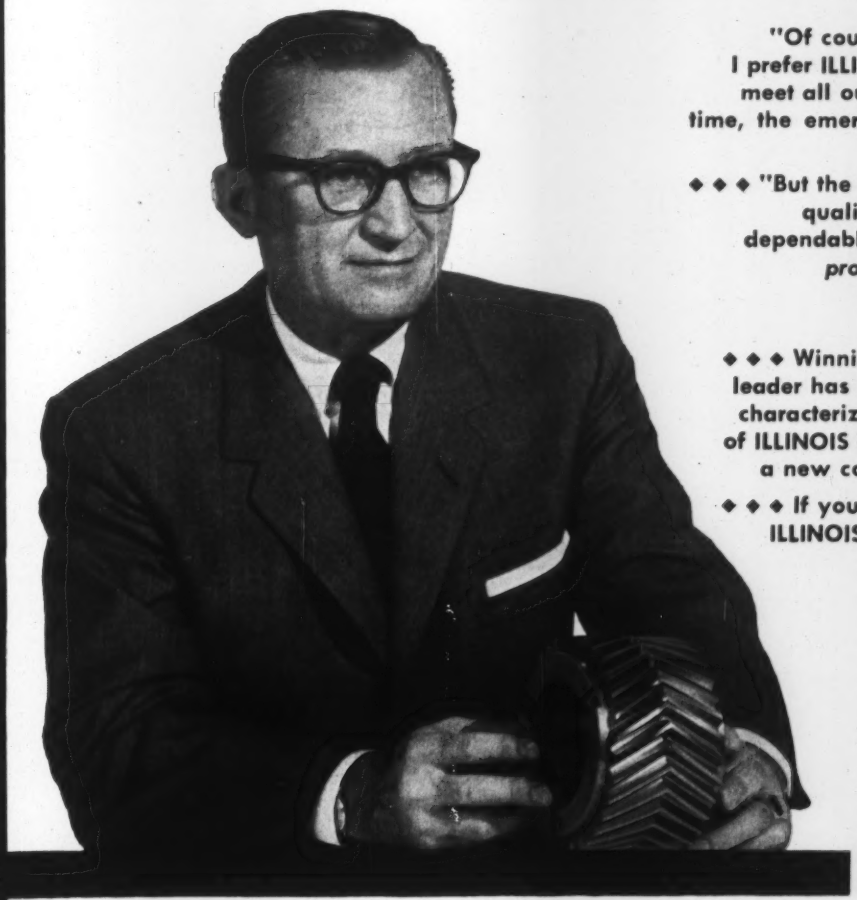
WHY BUY ILLINOIS GEARS?



THE ANSWER IS QUALITY... EVERYTIME!



"Of course, there are many reasons why I prefer ILLINOIS GEARS. I like the way they meet all our specs, the way they deliver on time, the emergency service we get when we need it—to mention a few.

◆ ◆ ◆ "But the one thing I like most of all is the quality of ILLINOIS GEARS—enduring, dependable quality I can trust because it is *proven by performance* . . . one more reason why we feel they are our most economical buy."

◆ ◆ ◆ Winning this recognition as the quality leader has been rightfully earned because it characterizes every step in the manufacture of ILLINOIS GEARS—a creed that established a new concept of quality in gear making.

◆ ◆ ◆ If you are not now using or specifying ILLINOIS GEARS find out about the gears that are *made right with quality as the first consideration.*

Look for this mark ILL® *the symbol on finer gears*

Gears for Every Purpose ... one gear or 50,000 or more

ILLINOIS GEAR & MACHINE COMPANY

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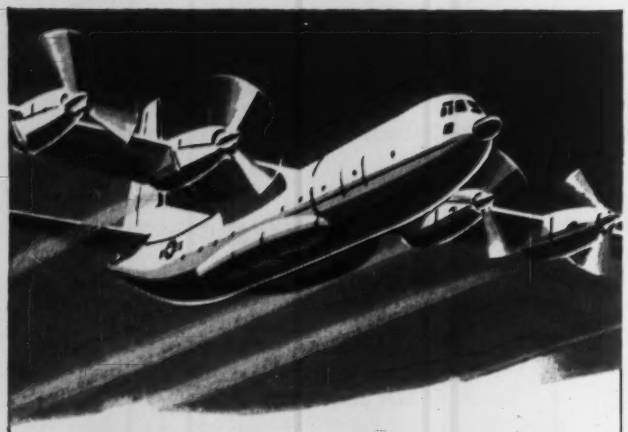
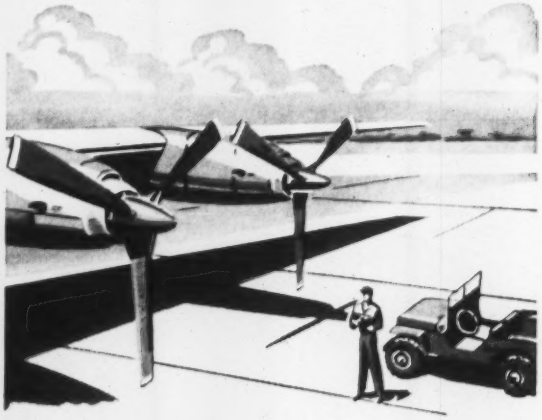


Curtiss-Wright TURBOLECTRICS

Propellers with the BRAINS



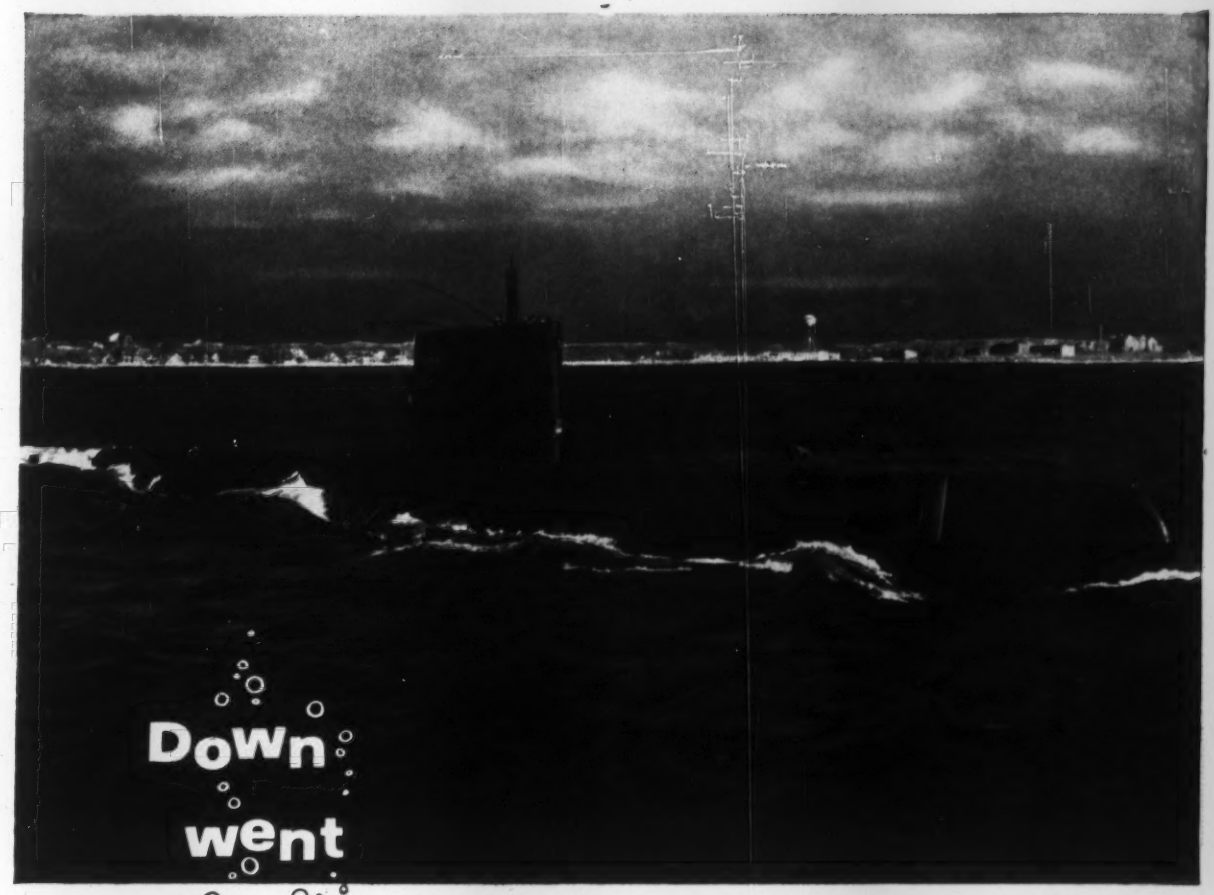
Converting the power of the new gas turbine or "turboprop" aircraft engines into useful thrust is a most exacting assignment for the time-honored propeller. It has to handle just about double any previous power . . . smooth out fast accelerations characteristic of these engines . . . control their power by the subtlest amount of pitch change on the blades . . . reverse to slow down and stop the momentum of some hundred tons of airplane.

With electromechanical brains for precise control . . . and with tough, one-piece extruded steel blades to handle unprecedented horsepower . . . Turboelectrics convert the basic operating efficiency of the turboprop into *flying* efficiency.

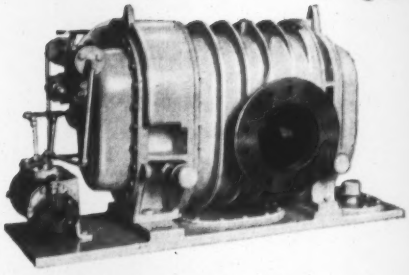
A leader in powerplant design, Curtiss-Wright also leads today in translation of turbine power into useful propeller thrust.

and BRAWN to TAME A TURBINE

PROPELLER DIVISION
CURTISS-WRIGHT
CORPORATION • CALDWELL, N. J.



McGinty to the bottom of the sea!



Spiraxial operating data U.S.S. Triton.
7" x 15" Spiraxial compressor rated at 15 psig delivers 1700 cfm at 3550 RPM requiring 83 HP, direct-connected to an electric motor. These Spiraxial compressors are recommended for applications requiring 15 to 30 psig.

Officers and men on board the U. S. Navy's new nuclear powered submarines live under conditions rarely experienced before in undersea craft. Because these ships can cruise for long periods to every corner of the world without refueling, the safety and comfort of the crew are of greater importance than ever.

To provide without fail both adequate ventilation exhaust and air pressure for ballast blowing, the U.S.S. Triton and other submarines now under construction are equipped with Spiraxial® compressors manufactured by Roots-Connersville.

These dual-purpose units were selected after intensive testing because they offer the advantages of high efficiency at varying operating pressures plus extreme compactness. They operate for ballast blowing and for ship's ventilation exhaust.

This is but one of the many new applications for this versatile air and gas compressor. For information on how industry is putting Spiraxial to work, write for Bulletin SC-354.

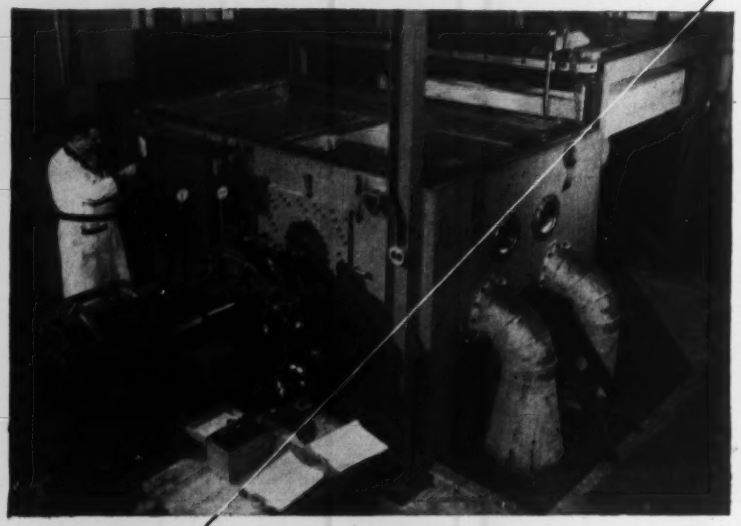
Engineers—unusual career opportunities await you at Roots-Connersville. Address your resume to Professional Employment Manager.

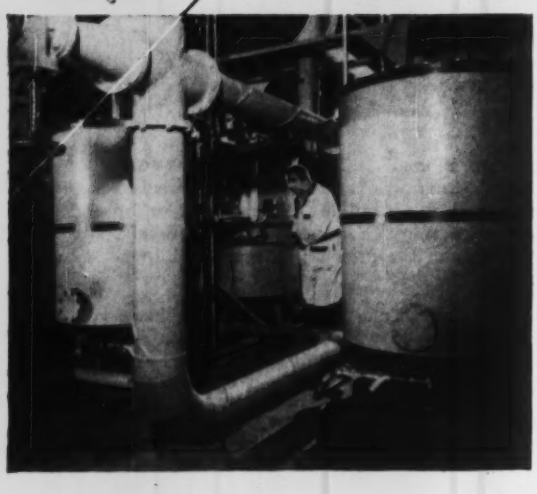
ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.

857 Michigan Avenue, Connersville, Indiana. In Canada—629 Adelaide St., W., Toronto, Ont.

Westinghouse altitude chamber simulates flight 23 miles up





▲ *Test chamber, showing motors for driving equipment on test inside.*

◀ *After the two refrigeration units have dropped the dewpoint to 38°, these two Lectrodryers* take it down to −100° F.*

Since temperatures drop below −80° F., air in this test chamber must be DRY

● Electrical equipment for aircraft, product of Westinghouse Electric Corp. at Lima, Ohio, must meet every possible hazard encountered in flight and on the ground. Their laboratory must be able, therefore, to simulate those conditions —even the 80 degrees below zero found 120,000 feet up.

Air at that altitude is DRY, so this Westinghouse laboratory dehumidifies the air blown through this test chamber to a −100° dewpoint. No chance that frost will form and cloud up test results.

For maximum economy in operation, the air is first "rough dried" by a refrigeration unit to 38° dewpoint. Then two BWC-1500 Lectrodryers remove the remaining vaporous moisture to a −100° dewpoint. Tests can be continued day after day, as these driers can be kept on-stream without interruption.

Whether you're DRYing experimentally or on production, there are Lectrodryers to handle the task. For literature on DRYing, write Pittsburgh Lectrodryer Division, McGraw-Edison Company, 335 32nd Street, Pittsburgh 30, Pennsylvania.

In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

Lectrodryer

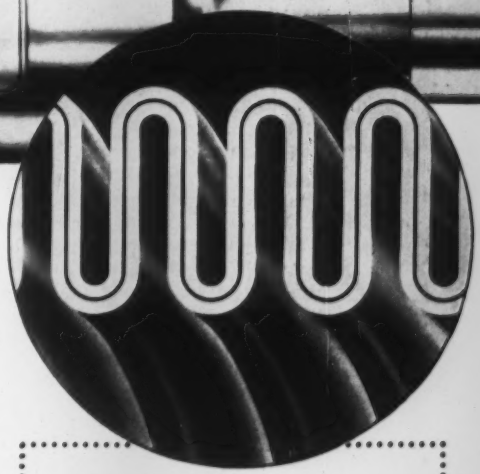
*REGISTERED TRADEMARK U. S. PAT. OFF.

INSTALL IT...FORGET IT!

Flexon®

PACKLESS EXPANSION COMPENSATOR

the no-maintenance way to take up expansion in heating lines



Specify it and install it now . . . forget it for the life of the building! There's no easier way to tell you the really important facts about the Flexon Expansion Compensator.

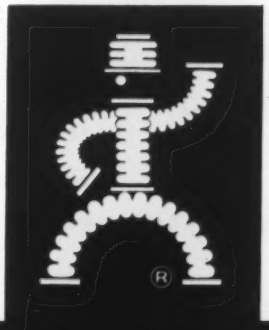
And there's no easier way to take care of pipe and tubing expansion, either. Flexon Expansion Compensators take little more space than the pipe or tubing that they replace. A mechanic can install one in minutes. Thousands of installations have proved them.

Standardize on this simple specification: Flexon Expansion Compensators for horizontal and vertical lines – Model L for low pressures – Model H for higher pressures. Write today for design and cost data.

The inside story

2-PLY CONSTRUCTION

The bellows is fabricated from two plies of specially-rolled metal to combine strength with flexibility. Bronze bellows for Model L; stainless steel for Model H.



Flexonics

corporation

EXPANSION JOINT DIVISION • 1305 S. THIRD AVENUE, MAYWOOD, ILLINOIS

EXPANSION JOINTS

METAL HOSE

NON-METALLIC HOSE

BELLOWS

AIRCRAFT COMPONENTS

Does your **Cylindrical** *problem call for a* **Centrifugal** *solution?*

If your product plans call for hollow cylindrical parts, give some thought to these facts. Manufacturers who had never seriously considered cast parts before are discovering important advantages in Sandusky centrifugal castings.

They're getting exceptional resistance to heat, corrosion, abrasion and stress, through the use of special alloys cast centrifugally . . . in diameters from 7" to 54", and lengths to 33 feet depending on diameter . . . and specially machined to specifications.

How can our versatile staff and facilities help you? Tell us your product requirements. Let us explore your ideas. Perhaps we can help solve your cylindrical problems through the vast foundry experience, metallurgical research and machining skills our 46 years offer.

Your request will bring more information promptly . . . or, if you prefer, a personal call by one of our engineers. Sandusky Foundry and Machine Company—Sandusky, Ohio.

Sandusky centrifugal castings offer you 4 important advantages:

1. ***SUPERIOR STRENGTH***—through non-directional mechanical properties
2. ***BETTER QUALITY***—machined castings are porosity-free
3. ***UNIFORM SOUNDNESS***—harmful inclusions are forced out by spinning motion
4. ***JOB-READY FINISHED CASTING***—reach you machined exactly to your specifications . . ; eliminating extra costs from rejects, down-time, loss of production, etc.

Sandusky Centrifugal Castings

Stainless steels—plain carbon and low alloy steels—wide variety of copper base compositions

TESTING and INSPECTION at Pittsburgh Piping

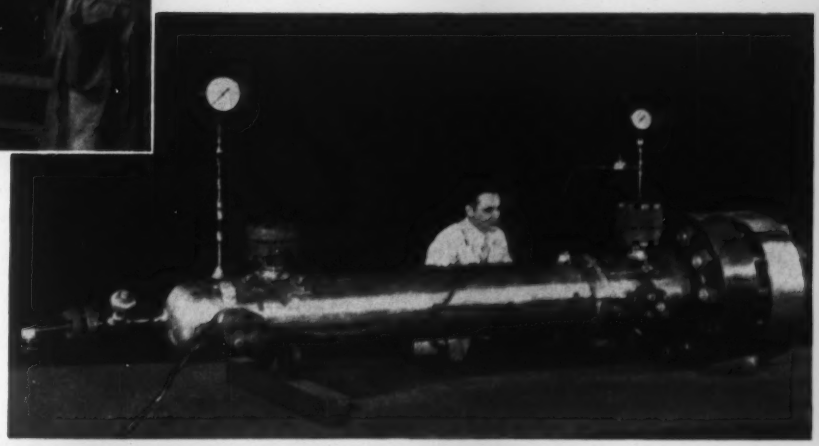
Fluorescent-penetrant examination detects surface defects. Pipe exterior is painted with fluorescent-fluid, then dusted with powder which draws fluid to surface where it is observed under ultra-violet light.

another
P. P. & E. service
which contributes to
Improved
HIGH-TEMPERATURE
HIGH-PRESSURE
PIPING

Fabricated chrome-moly header for central station piping system.

This testing instrument transmits ultra-sonic waves into pipe wall, with their movement around the pipe being indicated as a consistent pattern on the instrument's screen. Any internal defect in the pipe wall reflects the waves back to the instrument more quickly and is thereby revealed on the screen.

Close quality control is maintained throughout the fabricating process at Pittsburgh Piping by means of almost a score of different types of tests and examinations — three of which are shown on this page. Our technical staff supervises these procedures — checks all materials and production operations. This activity assures that each component, assembly, and the final piping system fabricated and erected by Pittsburgh Piping meets code and insurance requirements . . . fills the customer's specifications . . . and gives trouble-free service.



Hydrostatic testing at Pittsburgh Piping. This stainless steel surge tank is being tested at pressure up to 5,600 psi. Strain gauges are used to check closely for plastic deformation.

PRODUCTS AND SERVICES

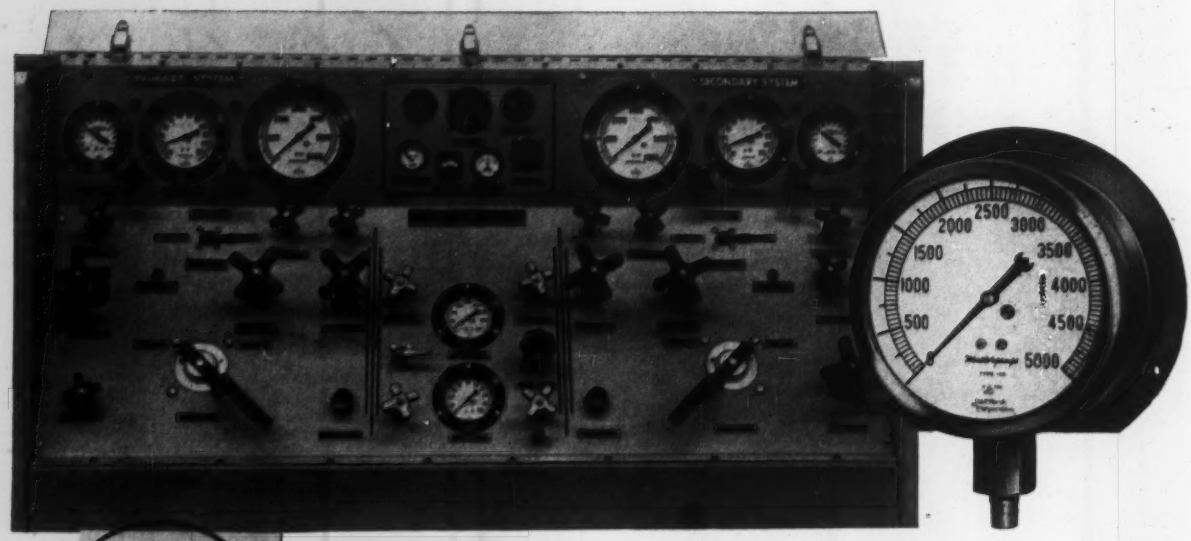
Carbon Steel Piping	Forged Piping Materials
Cast Iron Fittings	Headers
Cast Steel Fittings	Manifolds
Chrome-Moly Piping	Pipe Bends
Copper Piping	Stainless Steel Piping
Corrugated Piping	Van Stoning
Creased Bends	Welded Assemblies
Expansion Bends	Welded Stainless Steel Tubing
Flanges	Welding Fittings

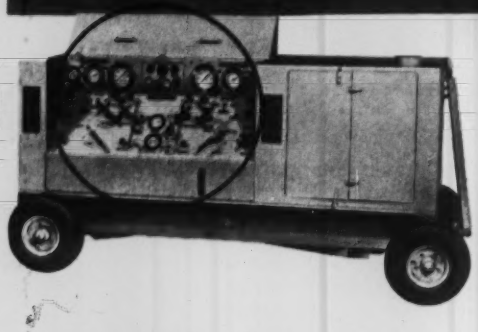
PP-23

Pittsburgh Piping
AND EQUIPMENT COMPANY
158 49th Street — Pittsburgh, Penna.
CANADA: CANADIAN PITTSBURGH PIPING, LTD.
835 BEACH ROAD—HAMILTON, ONTARIO

OFFICES IN PRINCIPAL CITIES

Atlanta	Whitehead Building
Boston	10 High Street
Chicago	Peoples Gas Building
Cleveland	Public Square Building
Hollywood	1828 North Alexandria Ave.
New Orleans	P. O. Box 74
New York	Woolworth Building
Syracuse	113 So. Salina Street
Toronto	68 Yonge Street



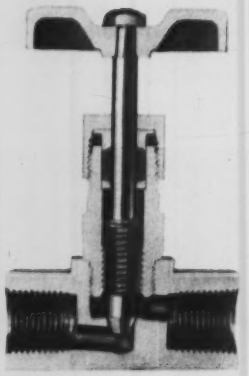


There is no more critical assignment for a pressure gauge!*

Illustrated above is a "close-up" of the instrument panel of one of Sun Electric's mobile Aircraft Hydraulic Systems Testers. The tough task of this unit is to test two jet aircraft at one time . . . to test them under particularly rugged conditions: temperatures from minus 65° F to plus 130°; altitudes up to 6000 ft.; extreme humidity.

It is therefore extremely significant that Sun Electric has equipped this tester with eight Marsh Pressure Gauges and nine Marsh Needle Throttling Valves. Obviously a test is no more conclusive than the instruments which sit in judgment . . . so there is no more exacting duty than this for pressure gauges and needle valves.*

Throughout industry—wherever the emphasis is on real accuracy, lasting accuracy—you will find Marsh instruments. In the Marsh Mastergauge, for instance, all the elements that contribute to gauge accuracy and stamina have been brought to a higher plane. There is the exclusive one-piece, leak-proof construction of socket, tube and tip by the Marsh "Conoweld" process . . . the sturdy "Marshalloy" Case, copper clad inside and outside . . . the precision movement with finer "coined" sector gear . . . the stainless steel tubes and sockets (where needed) for corrosion service . . . the famous Marsh "Recalibrator" to keep the gauge always accurate.



*** . . . or for a needle valve**

Guaranteed for working pressures up to 10,000 psi, and giving a smooth throttling on any lower pressure, the Marsh Needle Valve is another logical choice for the Sun Tester. The undeviating precision of Marsh Instruments has "rubbed off" on the Marsh Needle Valve to make it the finest in its field. Ask for catalog.

Ask for new catalog covering MARSH GAUGES

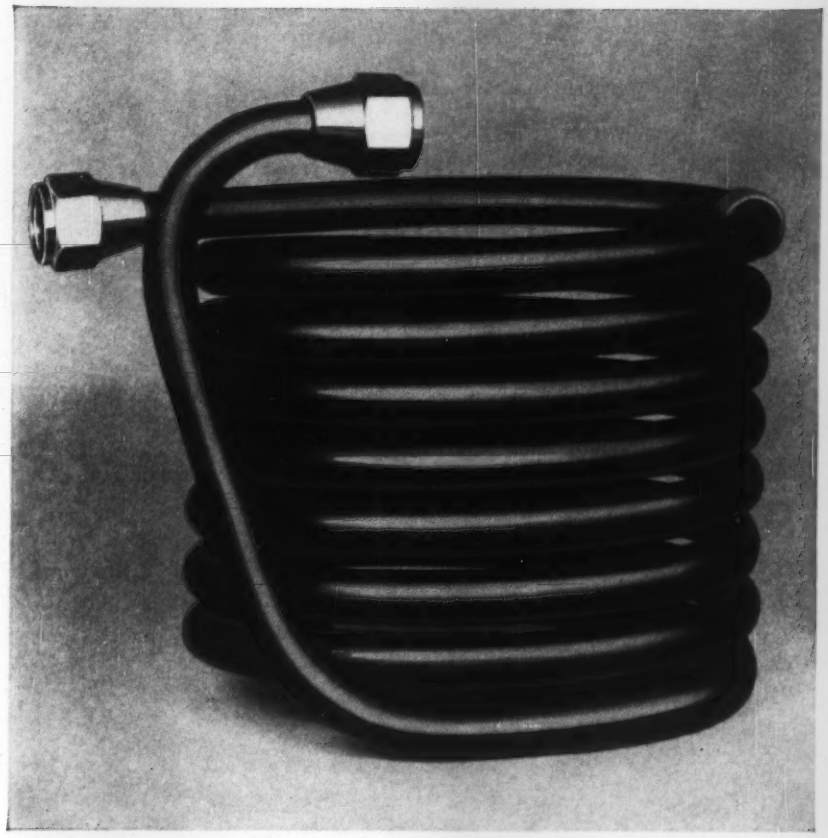
MARSH INSTRUMENT CO. *Sales Affiliate of Jas. P. Marsh Corp.,* **Dept. 29, Skokie, Ill.**
Marsh Instrument & Valve Co. (Canada) Ltd., 8407 103rd St., Edmonton, Alberta
Houston Branch Plant: 1121 Rothwell St., Sect. 15, Houston, Texas

MARSH GAUGES

"THE STANDARD OF ACCURACY"

THERMOMETERS • WATER REGULATING VALVES • SOLENOID VALVES • HEATING SPECIALTIES

How Bundy helped Eaton designers with oil cooler for hydraulic power steering



Oil-cooler coil for power-steering unit stands only 4¾" high, yet contains over 11 feet of ½" x .035" Bundyweld Tubing. The inside diameter of the coil measures just 4.88". This I.D. dimension is held to +⅛" tolerance. Ends are double-flared with fittings attached.

A heavy-duty power-steering pump made by Eaton Manufacturing Company is used in a closed system. Since this pump is driven by the fan belt, the unit must be mounted near the engine. But in this location, its hydraulic fluid absorbs engine heat. Problem: Cool the oil, and do it in limited space. For expert help, Eaton designers checked with Bundy®.

In a cooperative design effort, Eaton and Bundy engineers surrounded the hydraulic reservoir with this 4¾"-high coil of Bundyweld Tubing, to provide additional prime cooling surface. As hydraulic fluid is pumped through some 11 feet of tubing, it loses heat. Temperature reduction during each cycle averages between 25° and 35° F.

Because the coil is made from Bundyweld, it will stand up under severest operating conditions; deliver years of trouble-free service. Bundy's modern fabrication facilities mass-produce the part — coil the tubing, attach the fittings, and double-flare the tubing ends.

Customers in many industries have learned to depend on Bundy for design experience and know-how, as well as the finest in small-diameter tubing. An exclusive process, shown below, has made Bundyweld the standard of the automotive and refrigeration industries. *It's used on 95% of today's cars, in an average of 20 applications each.*

If you are looking for moneysaving answers to tubing design or fabrication questions, you'll find them at Bundy. Call, write or wire us today!

BUNDY TUBING COMPANY • DETROIT 14, MICHIGAN

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, ENGLAND, FRANCE, GERMANY, AND ITALY

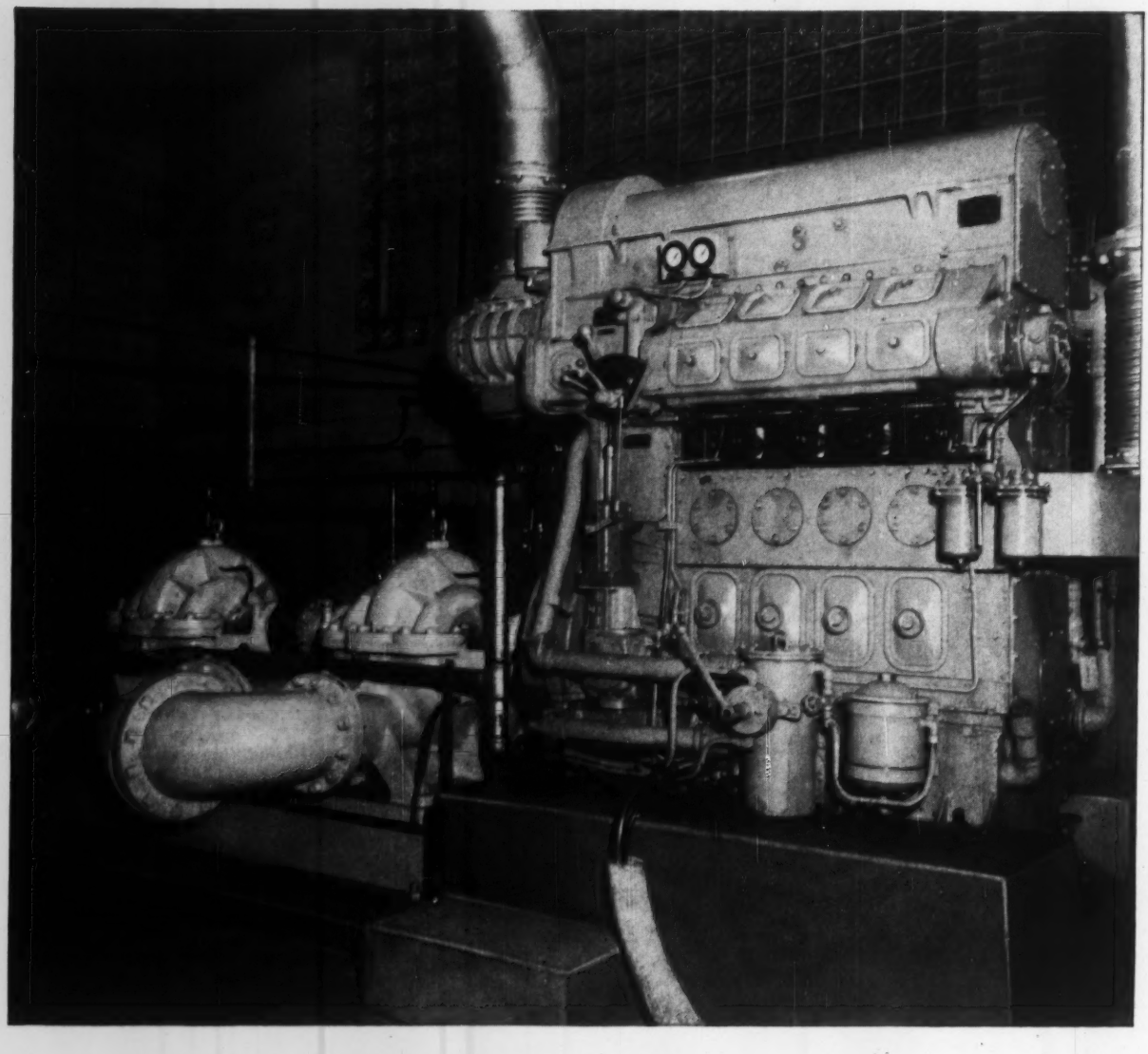
Bundyweld starts as a single strip of copper-coated steel. Then it's
. . . continuously rolled twice around laterally into a tube of uniform thickness and passed
through a furnace. Copper coating fuses with steel. Result . . .
SIZES UP TO ⅝" O.D.
Bundyweld, double-walled and brazed through 360° of wall contact.

NOTE the exclusive Bundy-developed beveled edges, which afford a smoother joint, absence of bead, and less chance for any leakage.

THERE IS NO REAL SUBSTITUTE FOR

BUNDYWELD® TUBING

DOUBLE-WALLED FROM A SINGLE STRIP



FAIRBANKS-MORSE TEAM

Cuts Pumping Costs in Half

Power costs at Canandaigua, New York, were running $24.68 for a million gallons of water pumped. Then a Fairbanks-Morse team of 300 horsepower Opposed-Piston diesel and two 10″ centrifugal pumps took over and made a power savings of 51%.

Originally installed as a standby unit, the Opposed-Piston diesel engine produced such obvious economies that it soon was scheduled for a major part of plant pumping—providing power to pump as high as two million gallons a day in the summer. The 10″ centrifugals operate in series and, though designed for 2500 g.p.m., they consistently average 2800 g.p.m. at a net head of 304′.

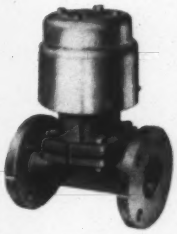
F-M engineering that matches power and pump can bring economy and increased efficiency to your specific pumping problem. Write for details on the type and size of pump you need—there are more than 50,000 models in the F-M pump line. And there's a "working model" of the Opposed-Piston engine contained in Bulletin No. AOX-350.15, waiting for your request. Fairbanks, Morse & Co., Dept. ME-8, Chicago 5, Illinois.

FAIRBANKS-MORSE

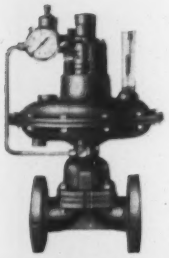
a name worth remembering when you want the BEST

DIESEL AND DUAL FUEL ENGINES · DIESEL LOCOMOTIVES · RAIL CARS · ELECTRICAL MACHINERY · PUMPS · SCALES · HOME WATER SERVICE EQUIPMENT · MOWERS · MAGNETOS

Barber-Coleman



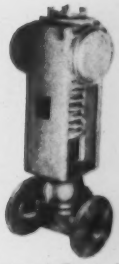
Bendix-Westinghouse Rotochamber



Conoflow

Fisher Governor

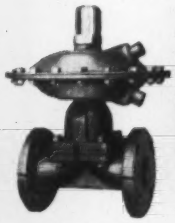
Foxboro Reversible Stabiflo



General Controls Hydramotor

GRINNELL-SAUNDERS DIAPHRAGM VALVES with famous name POWER OPERATORS

Grinnell Air Motor, Spring Loaded

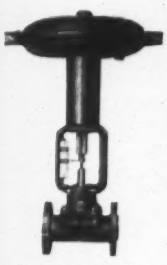


Grinnell Air Motor, Double-Acting

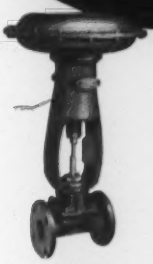
Grinnell Piston

Hammel-Dahl Close-Coupled

Hammel-Dahl Preloaded



Kieley & Mueller



Mason-Neilan

Minneapolis-Honeywell

Philadelphia Gear Limitorque

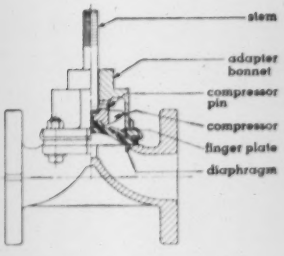
Taylor Motosteel

GRINNELL-SAUNDERS Diaphragm Valves are easily equipped for power operation — by combining any of numerous power operators, a sliding stem bonnet assembly, and a valve body. The sliding stem bonnet can be modified to accommodate any make of power operator, pneumatic or electric.

Grinnell-Saunders Diaphragm Valves are unsurpassed for handling materials as diversified as corrosive fluids, gases, beverages, foods . . . in lines where corrosion, abrasion, contamination, clogging, leakage and maintenance are costly factors.

The operating principal of the Grinnell-Saunders Diaphragm Valve is simple. The resilient, flexible diaphragm is lifted high when the compressor is raised and pressed tight against the body weir when the compressor is lowered.

Grinnell valves are available with body, lining, and diaphragm materials to meet different service conditions. For further information, write Grinnell Company, Inc., 254 West Exchange St., Providence, R. I.



This sliding stem bonnet is specially designed for power operation. The power operator is attached to the adapter bonnet and to the threaded end of its free-sliding stem. Thus, the operating force is applied *directly*. The stem, in turn, is directly connected to the compressor which opens and closes the valve when power is applied. This sliding stem bonnet is interchangeable with other bonnet designs.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

"You're kidding! Cut housekeeping costs 20%?"

You heard right! Many firms have been getting 20% lower housekeeping costs after installing Pangborn Dust Control in their plants. That's because Pangborn Collectors trap dust controlled at the source . . . won't permit uncontrolled dust to settle on walls, floors, working surfaces. Of course, we can't promise *your* housekeeping costs will drop as much as 20%. But less painting, sweeping, washing can cut your overall maintenance costs 5%, 10%, 15% or even more.

What's more, Pangborn gives you other benefits of longer machinery life, higher employee efficiency, extra profits from any salvage value and better employee and community relations. And Pangborn offers a complete line of dust collectors for all jobs.

Discover how you can profit from Pangborn Dust Control! Write for Bulletin 922 to PANGBORN CORP., 2200 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control and Blast Cleaning Equipment.*

Pangborn CONTROLS DUST

HYDRECO Gear Pump

Dual-Vane Double Pump with Valve Panel

In Your Search for MORE...MORE...MORE—Look to FLUID POWER

WATERTOWN DIVISION

Watertown, N. Y.

Railroad Air Brake equipment of all types; STRATOPOWER Hydraulic Pumps and Motors for Aircraft, to 5000 psi for operation to 400° F.

KALAMAZOO DIVISION

Kalamazoo, Mich.

HYDRECO Hydraulic equipment for industrial and mobile applications. Gear and Dual-Vane Pumps and Motors to 2000 psi, to 120 gpm, to 120 hp. Control Valves to 2000 psi and 150 gpm. Cylinders: Telescopic, Single and Double-acting to 10" diameter, strokes to over 20 ft.

AURORA PUMP DIVISION

Aurora, Ill.

AURORA Centrifugal Pumps to 8500 gpm and 600 ft. heads. APCO Turbine type Pumps, 5 to 150 gpm, heads to 700 ft. Condensate Return Units 800 to 100,000 sq. ft. radiation.

KINNEY MFG. DIVISION

Boston, Mass.

High Vacuum Mechanical Pumps, single stage, 13 to 780 cfm, pressures to .01 mm Hg; two stage, 2 to 46 cfm, pressures to .0002 mm Hg; Mechanical Booster Pumps, 30 to 5000 cfm, pressures to .0001 mm Hg. Rotary Liquid Handling Pumps to 3000 gpm.

VACUUM EQUIPMENT DIVISION

Camden, N. J.

Complete KINNEY Vacuum Systems—Vacuum Furnaces (Arc, Induction or Resistance), Evaporators, Optical Coaters and Metallizers, TV Tube Aluminizers; Oil Diffusion Pumps, Gages, Valves and Oils.

More pieces per hour, greater precision, more functions from equipment, more goods to more people faster . . . these are the areas wherein Fluid Power performs today's miracles in production and distribution. Engineers in The New York Air Brake Company are singularly well equipped with "know-how" and experience to answer YOUR problems.

HYDRECO Gear and Dual-Vane Pumps and Fluid Motors, Control Valves and Cylinders run the gamut of Industrial and Mobile Equipment applications . . . for machine tools; lift trucks; farm and construction equipment; conveyors; oil well, mining or lumbering machinery; for operating winches, cargo booms, or for hatch covers. Name a function on land or sea requiring push, pull, press, raise, lower or rotary motion, and the names HYDRECO and Dual-Vane are your answer.

In the air—STRATOPOWER Hydraulic Pumps and Motors combine amazing weight/horsepower ratios with equally amazing ability to perform dependably at all altitudes and high temperatures.

In Liquid Handling, AURORA Centrifugal and Turbine-type Pumps and KINNEY Heliquad and Rotating Plunger Pumps provide the practical and economical means for moving "anything that will flow through a pipe," from gasoline to asphalt.

KINNEY High Vacuum Pumps, producing pressures down to 0.0001 mm Hg., afford still another important tool to make things better, faster and at lower cost. High vacuum is *the* new technique in many industries.

What are *your* "MORE" problems? Are you fully aware of what *Imaginative Engineering* of The New York Air Brake Company can do to help you solve them?

Complete your file of data on new developments in Hydraulic, Liquid Handling and Vacuum Equipment. Write for catalogs today.

THE NEW YORK AIR BRAKE COMPANY

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PRECISION "O" RINGS

Quality proved by all ASTM Tests

Precision "O" Rings made from Compound 830-70 meet or exceed all the SAE 120-R requirements for heat, oil resistance and other properties.

100% better compression set. Remarkable superiority in 300° F hot oil. 100% better Fatigue Test life.

For manufacturers of automobile, machine tool, farm equipment and similar equipment, Precision Compound 830-70 is your answer to positive long sealing life.

Have a sealing problem? You'll find the answer at Precision! There's a Precision engineer ready to help you.

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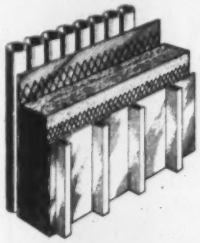
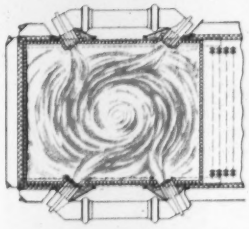


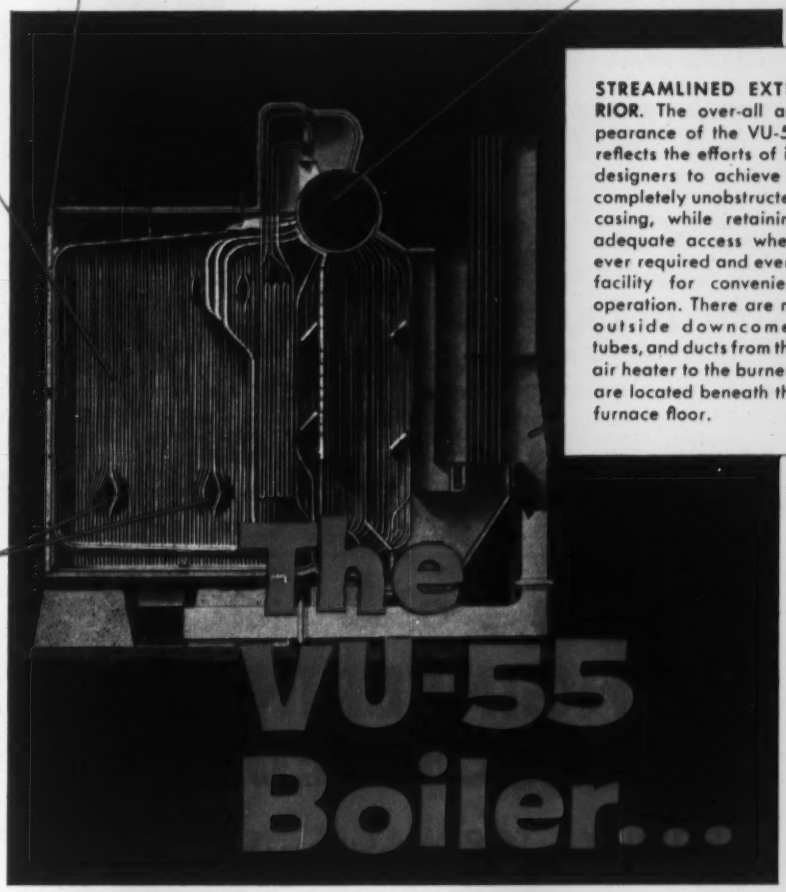
DOUBLE WALL, PRESSURE-TIGHT CASING. The latest development in casing construction for pressure firing of boilers in the size class of the VU-55, this casing is designed to assure life-time tightness with minimum heat loss. Pressure firing permits the elimination of an induced draft fan with its attendant operating and maintenance costs. Construction consists of tangent tubes backed up successively by welded steel panels, 4 inches of high quality insulating material and an outer steel casing formed as shown to provide adequately for expansion and assure ample strength. Low heat loss and the tightness required for pressure firing are assured by this double-wall construction.

HIGH STEAM QUALITY. Equipped with a large (60-in.) steam drum, the VU-55 has generous water capacity and steam reservoir space. C-E drum internals assure high quality steam at all ratings.

TANGENT FURNACE TUBES. The VU-55's furnace tube arrangement provides complete heat-absorbing, water-cooled protection on all furnace walls. Furnace maintenance is minimized, refractory expense is eliminated, heat absorption rates per sq. ft. are higher.

TANGENTIAL FIRING. More than 20 years of application experience have established the exceptional advantages of tangential firing. About 90 per cent of Combustion's large utility installations use this advanced method of firing. Flame streams from the four burners impinge upon one another at high velocity, as shown, creating a turbulence unattainable by any other method of firing. The result is rapid and complete combustion. As the gases spiral upward, they sweep all furnace heating surfaces, assuring a high rate of heat absorption.





STREAMLINED EXTERIOR. The over-all appearance of the VU-55 reflects the efforts of its designers to achieve a completely unobstructed casing, while retaining adequate access wherever required and every facility for convenient operation. There are no outside downcomer tubes, and ducts from the air heater to the burners are located beneath the furnace floor.

Custom Features, Standard Sizes, Advanced Design

The VU-55, newest of the C-E line of Vertical Unit Boilers, represents the closest approach to central station performance yet achieved in standardized boilers in its capacity range.

Its design combines a number of time-tested and service-proved features, such as Tangential Burners, double wall, pressure-tight casing, and tangent furnace tubes. In addition, this bottom-supported unit requires no outside supporting steel, is economical of space and streamlined in appearance.

It is available in 5 sizes for capacities from 50,000 to 120,000 lb per hour. It is designed for 3 pressure ranges (250, 500 and 750 psi) and can be equipped with a superheater to provide temperatures up to 750 F. Either a tubular or a regenerative air heater is available.

The VU-55 Boiler is symmetrical in design, performs efficiently over a wide range of output, and is easy to operate and maintain.

It is, in fact, the boiler with the custom features and the advanced design.

COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

Canada: Combustion Engineering-Superheater Ltd.

C-E

B-978A

all types of steam generating, fuel burning and related equipment; nuclear reactors; paper mill equipment; pulverizers; flash drying systems; pressure vessels; soil pipe.

It's ELLISON for accuracy!

STRAIGHT LINE DRAFT GAGES

Unit mechanism —readily accessible or removed. Non-parallax pointers. All diafram types have free-floating, long-life diafram. Bell type gages, Bulletin 122—Diafram type, Bulletin 124.

DIAL DRAFT GAGES

Unit mechanism readily accessible or removed. One, two or three pointers. Powerful movement on knife edge bearings. Ask for Bulletin 122.

INCLINED DRAFT GAGES

Constant zero under wide range in room temperature. Level and tube are replaceable in the field. Stationary and portable types. Also accessories and pitot tubes. Ask for Bulletin 109.

U-PATH STEAM CALORIMETER

Combines throttling, separating and re-evaporating calorimeter in a single unit. Accuracy within 2° F. Simple to use. Ask for Bulletin 118.

ELLISON DRAFT GAGE CO.

552 W. MONROE ST. Since 1896 CHICAGO 6, ILL.

THE ELLISON LINE ALSO INCLUDES:

Draft Gages, Bell and Diafram—Inclined Draft Gages—Portable Inclined Vertical Tube Gages—Vertical Tube Gages—Oil, Heavy Liquid and Mercury—Single and Multi-Tube-Saturator Gages—U Gages—Stationary and Portable—Air Filter Gages—Dial and Inclined Tube Types—Pitot Tubes—U Path Steam Calorimeters—Portable Gas Analyzers-Orsat Type

"MONOBALL"

Self-Aligning Bearings

CHARACTERISTICS

	ANALYSIS	RECOMMENDED USE
1	Stainless Steel Ball and Race	For types operating under high temperature (800-1200 degrees F.).
2	Chrome Alloy Steel Ball and Race	For types operating under high radial ultimate loads (3000-893,000 lbs.).
3	Bronze Race and Chrome Steel Ball	For types operating under normal loads with minimum friction requirements.

Thousands in use. Backed by years of service life. Wide variety of Plain Types in bore sizes 3/16" to 6" Dia. Rod end types in similar size range with externally or internally threaded shanks. Our Engineers welcome an opportunity of studying individual requirements and prescribing a type or types which will serve under your demanding conditions. Southwest can design special types to fit individual specifications. As a result of thorough study of different operating conditions, various steel alloys have been used to meet specific needs. Write for revised Engineering Manual describing complete line. Dept. Me-57.

SOUTHWEST PRODUCTS CO.

1705 SO. MOUNTAIN AVE., MONROVIA, CALIFORNIA

Opportunities Unlimited

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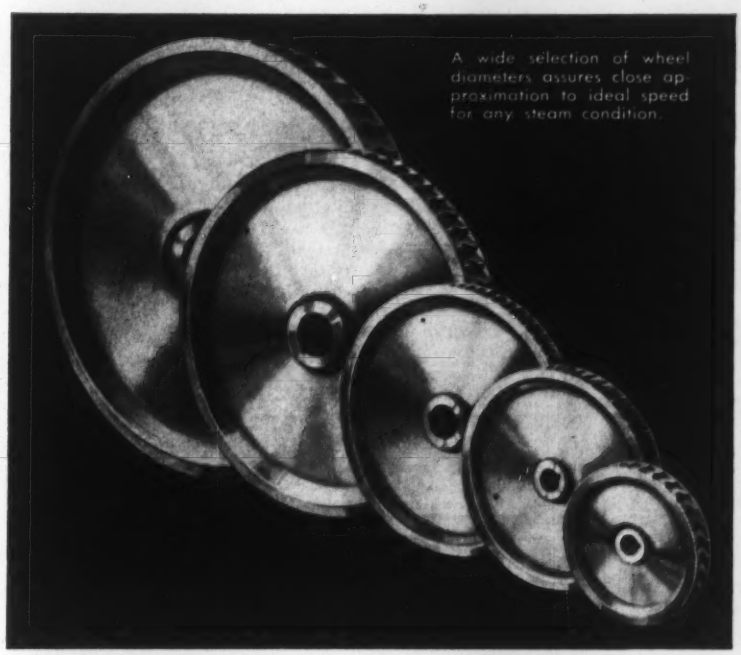

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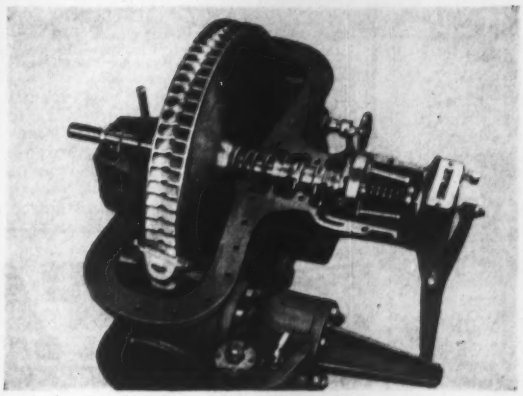

Terry wheel turbine with cover removed to show the solid wheel. There are no separate parts to loosen or work out. Blade clearances are generous.

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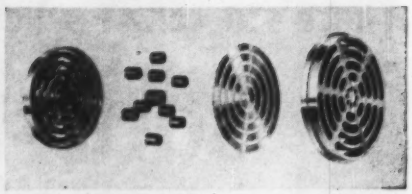

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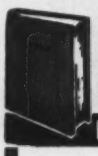

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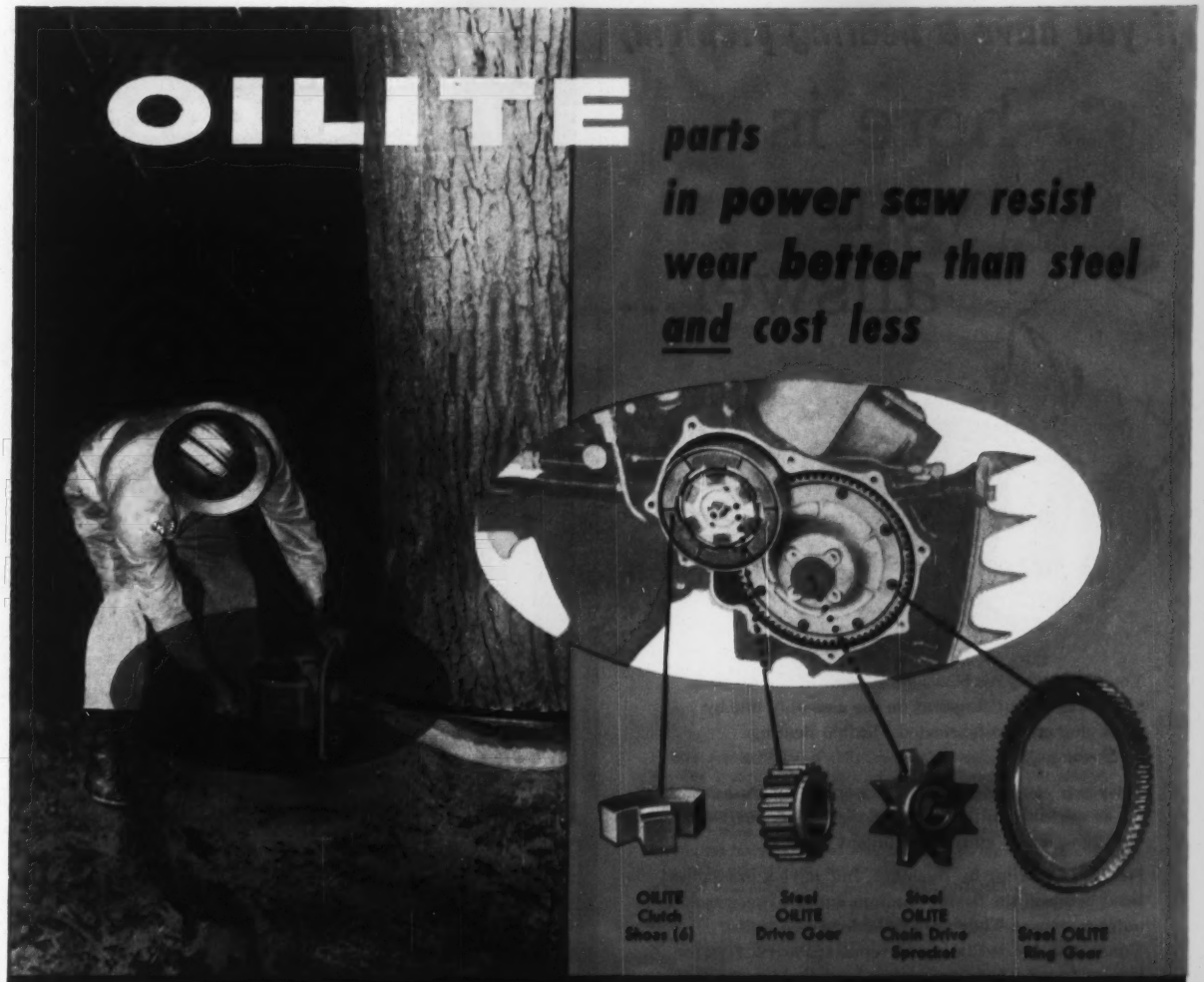

Another cost-saving application of **Amplex Powder Metallurgy**

With a modern power saw—easy does it. It's easier on the inside, too, because this manufacturer has equipped vital components with extra tough, greater wear resistant OILITE precision parts. The manufacturer's report indicates that OILITE powder metal sprockets and gears offer *greater wear resistance than alloy steels.*

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What this manufacturer is accomplishing with OILITE precision parts, you can too. Or, perhaps, in your case OILITE self-lubricating bearings and bearing materials can help you lick the problem of providing lubrication in hard-to-get-at places. In permanent metal filters, too, OILITE provides a wide choice of shapes, sizes and porosities to meet product requirements.

Amplex—volume producer of Chrysler-engineered powder metal components—can meet your production schedules with on-time deliveries in any quantity.

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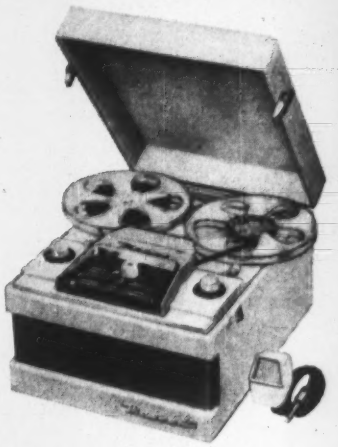
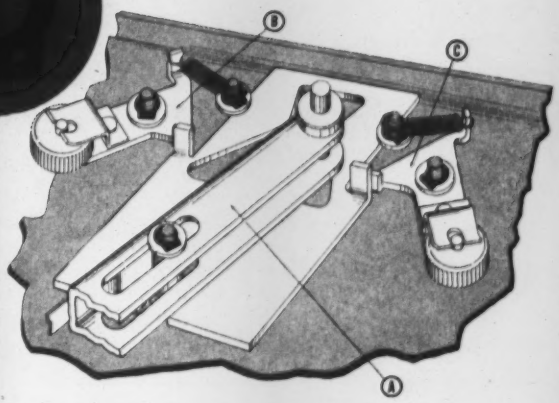
ME-8

Waldes Truarc grip rings used on die-cast studs eliminate threading, tapping, other costly machining



Mark Simpson Manufacturing Co., Long Island City, N. Y., uses Waldes Truarc series 5555 Grip Rings to secure parts to studs of the zinc die-cast base of its "Masco 500" portable tape recorder.
The rings—which need no grooves—replace nuts, screws, cotter pins and other types of fastening devices which require threading, tapping, drilling and other expensive machining operations. Because a single cracked or broken stud would render the entire cast base useless—and with it, all assembly completed to that point—the rings also eliminate extremely costly rejects.



Pivot Assembly of shift lever (A) is secured by a single Waldes Truarc Grip Ring and washer. Because the washer must be installed over the shift level in a sliding fit, critical tolerances would have to be maintained if a screw or cotter pin were used. The Truarc Grip Ring eliminates that problem: it requires no groove and may be seated over the washer at any point on the stud, automatically compensating for accumulated tolerances in the parts. BRAKE ASSEMBLIES (B and C) use Grip Rings to secure the brake wheel and spring subassemblies. Here again problems of critical tolerances are avoided and expensive rejects eliminated.

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ME-089

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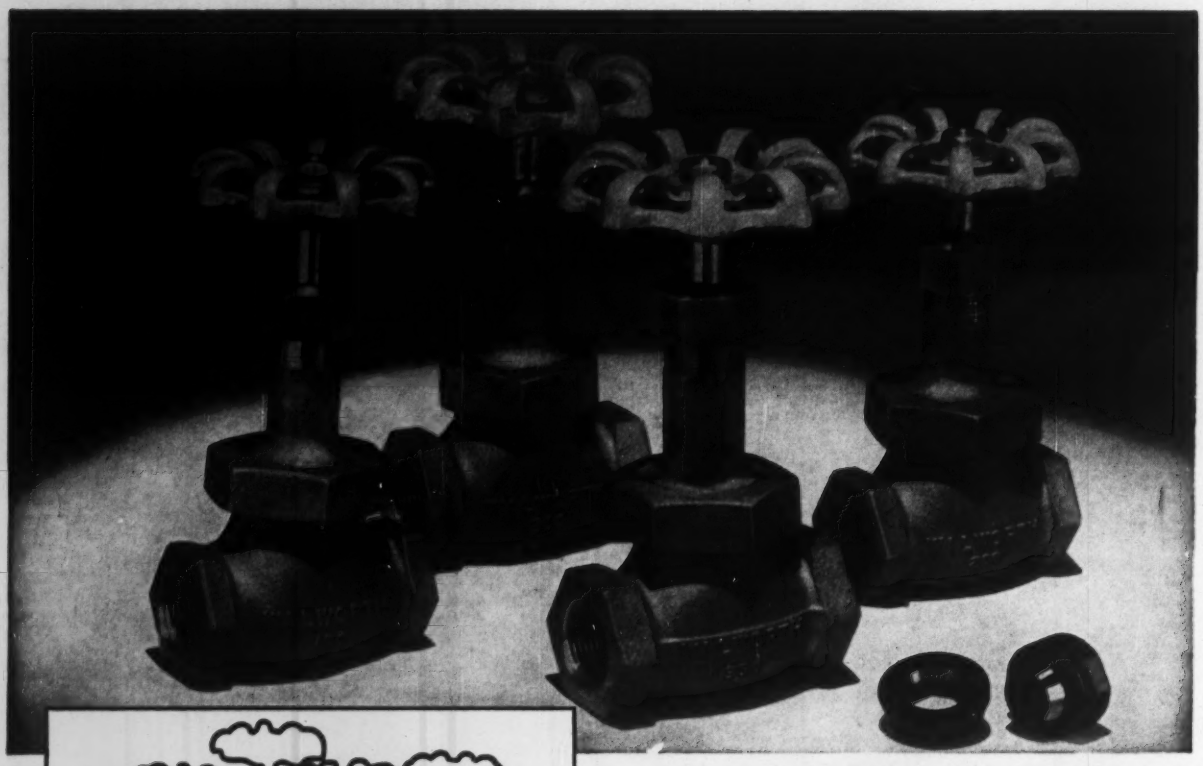

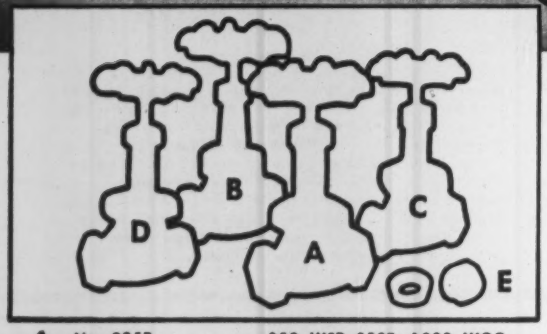

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C — No. 245P. . . . . 200 WSP 550F, 400 WOG
D — No. 237P. . . . . 150 WSP 500F, 300 WOG
E — "500 Brinell" Stainless Steel Plug Type Seat and Disc

Walworth offers four lines of Bronze Globe Valves with stainless steel, plug-type seats and discs. Advantages of these valves include:

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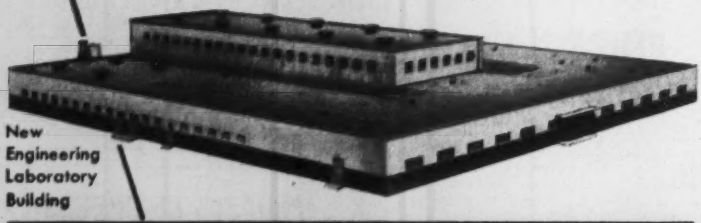

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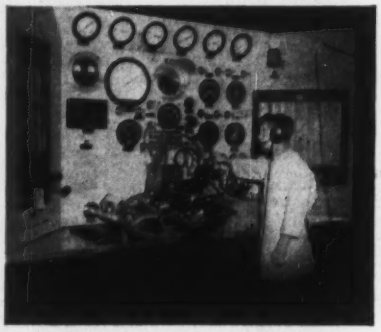

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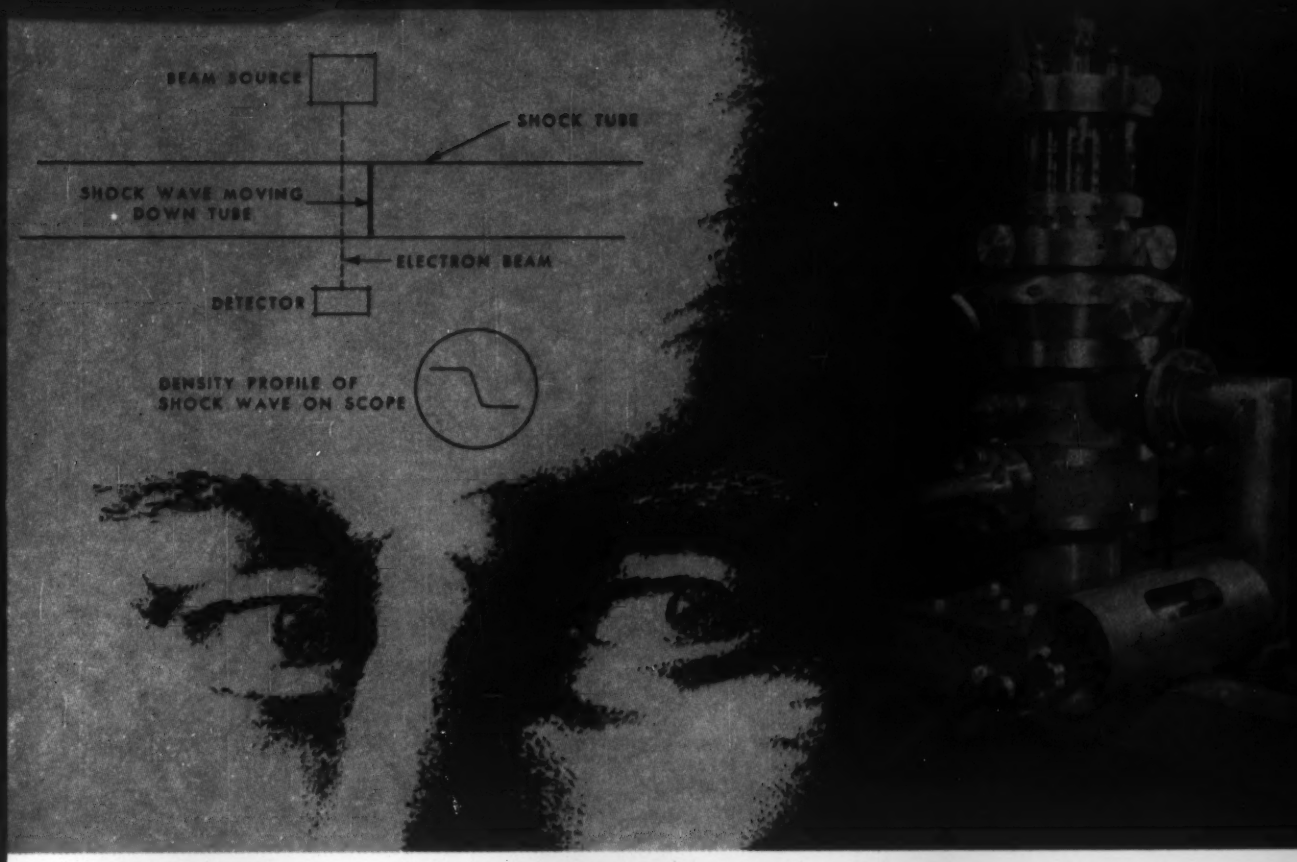

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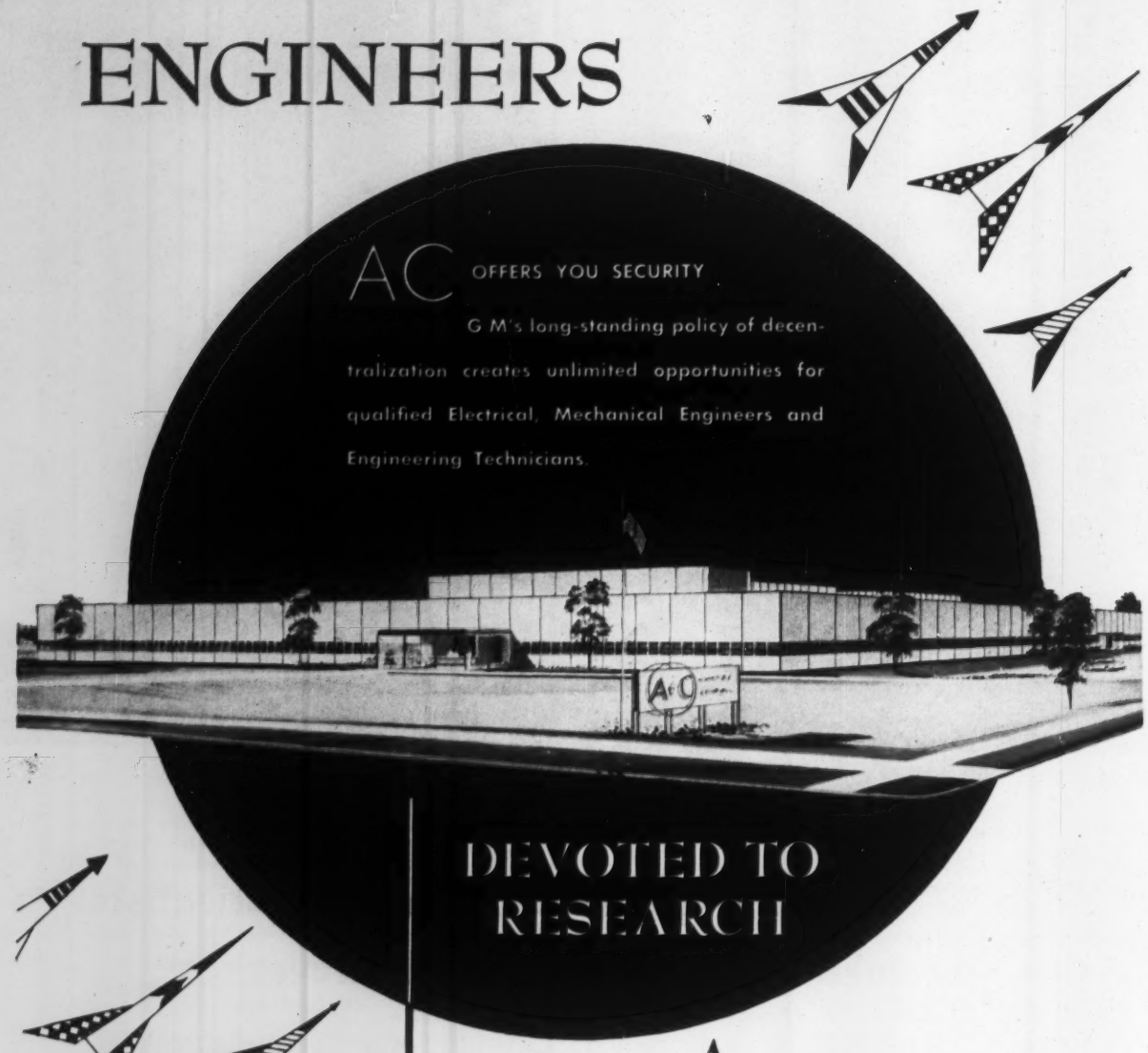

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Milwaukee 2, Wisconsin • Flint 2, Michigan

Don Walter, B.S. M.S., achieved an outstanding academic record at Cal Tech, Class of '40, while earning seven varsity letters. Today as Vice President in charge of Engineering and Van Nuys Operations, Don utilizes his technical and teamwork background to lead Marquardt's engineering and development manufacturing. He is an example and exponent of Marquardt's management philosophy.

ENGINEERING MANAGEMENT = OPPORTUNITY AT MARQUARDT

Every day, professional engineers are finding *outstanding* career development opportunities at Marquardt Aircraft. Because, at Marquardt, there is no ENGINEER/BARRIER.

Marquardt is guided by a management team with an *engineering* philosophy.

This management team is familiar with, understands and respects the contributions of engineers.

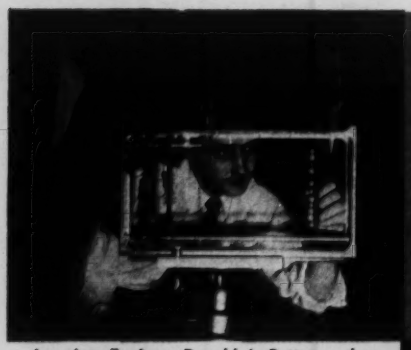
This engineering philosophy eliminates all traces of the ENGINEER/BARRIER—that invisible management level beyond which engineers cannot advance.

Professional engineers interested in joining a company which offers this management team and this engineering management philosophy are invited to write *that* letter to Jim Dale, Professional Personnel, 16550 Saticoy Street, Van Nuys, California.

marquardt AIRCRAFT CO.

VAN NUYS, CALIFORNIA OGDEN, UTAH

FIRST IN RAMJETS



Associate Engineer Donald A. Patterson demonstrates a problem in pluggable unit layout.

Field Engineering Instructor Joseph Rechloff explains basic display console functions at IBM, Kingston, N. Y.

Associate Engineer Robert M. Blake points out a feature of an advanced magnetic tape circuit development.

You'll find a new challenge DEVELOPING the world's largest computers at Kingston

Staff Engineer Michael S. Zucker and associates plan electronic digital computer systems.

The design and development of SAGE (Semi-Automatic Ground Environment) computers, part of our nation's radar defense system, offer stimulating new challenges to creative engineers at IBM Kingston.

Projects currently in process include: Digital and analog systems . . . advanced circuitry . . . electronic packaging . . . communications engineering . . . simulation studies . . . air traffic control . . . automation.

If you are an electrical or mechanical engineer, a mathematician or a physicist—and want to do development work—you owe it to yourself to investigate the exciting possibilities that SAGE computers offer you at IBM Kingston.

Computer Student Stanley J. Ostrowski studies wave forms in the IBM Computer Engineering School laboratory.

FOR DETAILS,
just write, outlining background and interests, to:
Mr. R. A. Whitehorne, Dept. 508
Mgr. of Engineering Recruitment
International Business Machines Corp.
590 Madison Avenue, New York 22, N. Y.

IBM **MILITARY PRODUCTS**

DATA PROCESSING
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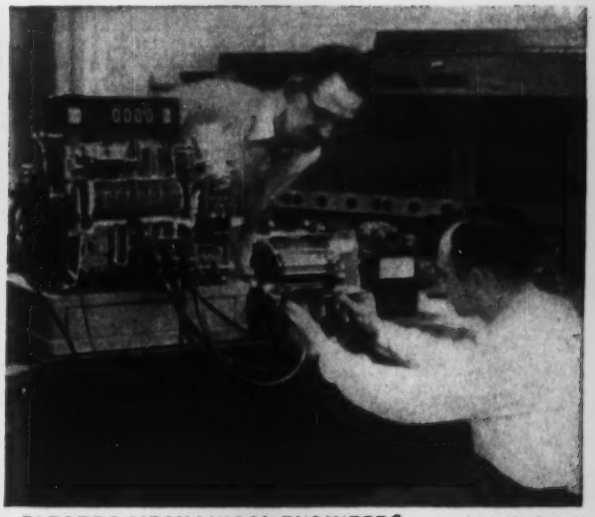
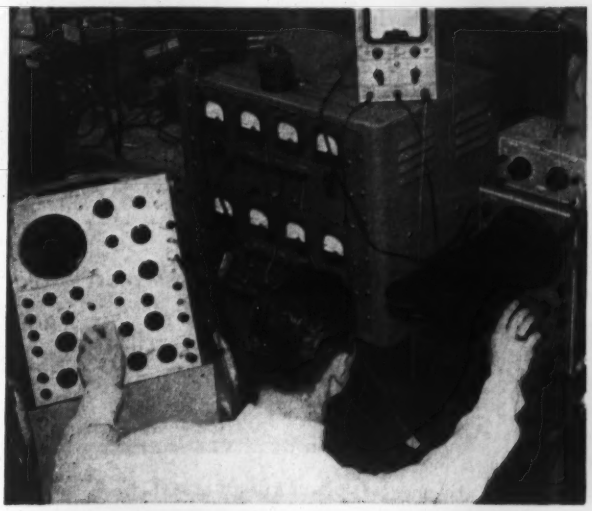
SUPPLIES
TIME EQUIPMENT

Plants and laboratories: Endicott, Kingston, Owego, Poughkeepsie, N. Y.; Lexington, Ky.; Rochester, Minn.; San Jose, Calif.

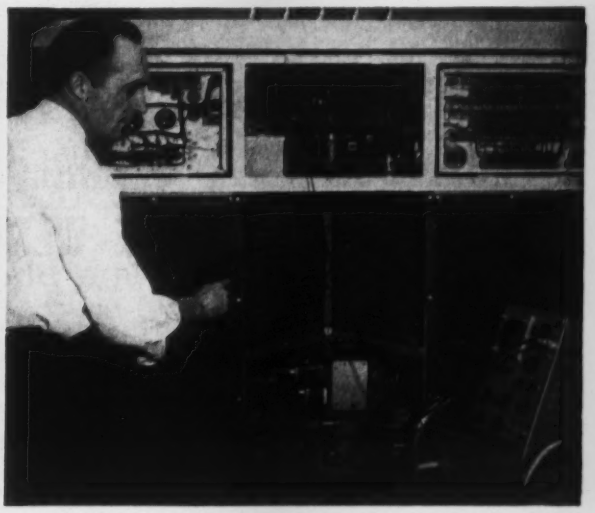
MECHANICAL ENGINEERS are using their skills in the design and development of new mechanisms required for business machines and for those mechanical products which are associated with electronic data processing equipment.



ELECTRO-MECHANICAL ENGINEERS are constantly faced with the problems of capturing information from the various input devices and converting this information into a usable form for subsequent use in data-handling equipment.



ELECTRONIC ENGINEERS enjoy an unparalleled freedom in the development of new types of circuitry and components which are necessary to maintain leadership in the competitive field of record-keeping automation.



COMPUTER ENGINEERS backed by the company's computer research since 1938 are developing an economical, flexible digital computer to meet the requirements of all record-keeping applications.

ENGINEERING UNLIMITED

AT ONE OF THE WORLD'S MOST SUCCESSFUL CORPORATIONS

If you are looking for a challenging opportunity with an established company which has tripled its sales in ten years—one that offers excellent starting salaries as well as permanent positions . . .

Act at once! Send resumé of your education and experience to Employment Department, Technical Procurement Sec. M The National Cash Register Company, Dayton 9, Ohio.

NCR

THE NATIONAL CASH REGISTER COMPANY

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It isn't often that you can combine ideal living conditions with outstanding advancement opportunities. At Bendix Guided Missiles we sincerely believe we can offer you both.

We are sure that you would enjoy living in an attractive community convenient to metropolitan centers and recreational areas.

And, we are equally confident that as prime contractor for the important and successful Talos Missile, no one can offer a greater variety of interesting and challenging job opportunities in the guided missile field.

If you would like proof of these strong statements, why not fill out the coupon and send for a copy of our thirty-six-page booklet "Your Future in Guided Missiles". It not only gives a detailed story of guided missile operations, but it also presents interesting facts about living conditions in the area, the many special employee benefits, and the wide range of specific job opportunities we have to offer.

Send for your copy of "Your Future in Guided Missiles" today.

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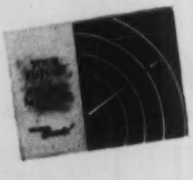

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Gentlemen: I would like more information concerning opportunities in guided missiles. Please send me the booklet "Your Future In Guided Missiles".

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To supervise the development and design of a wide variety of Power Transmission Devices.

Excellent opportunity with reputable manufacturer now engaged in this business.

Location—Middle Atlantic area.

Give full particulars, education and experience.

Address CA-6275, % "Mechanical Engineering."

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Excellent opportunity with midwest manufacturer of mechanical power transmission components. Desire man experienced in sales engineering work with OEM and industrial distributor sales. Salary and expenses—Age 27–35 preferred but not necessarily a requirement. Send photo and complete resume.

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Attractive staff positions available with affiliates of STANDARD OIL COMPANY (N. J.) in South America and the Caribbean area:

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MAINTENANCE ENGINEERING—Studies, surveys, economics, trouble shooting to improve mechanical work efficiency, new equipment evaluation, standards, mechanical work systems and procedures.

PLANNING ENGINEERING—Short, intermediate and long-range planning and follow up of mechanical work force for maintenance and construction work, contract preparation and follow up, coordination of all manpower planning activities.

Liberal salaries, benefit plans and vacation policy.

—WRITE—

Giving age, complete address, marital status, education and details of previous experience to:

BOX 308-M
RADIO CITY STATION
New York 19, New York

Left to right: J. M. Motis, Equipment Installation Group Engineer, G. H. Estabrook, Department Manager of Airframe Propulsion and Internal Systems, and A. R. Schroter, Senior Structures Design Engineer discuss design vehicle nose structure and related equipment.

To engineers with keen interest in STRUCTURAL DESIGN FOR MISSILES

Major programs at Lockheed Missile Systems require a high order of achievement in structural design.

Emphasis is on new ideas, new techniques, new approaches.

A number of positions have been created for engineers to:

- Design missile structures to an optimum strength-weight ration using newest material and fabrication methods;
- design models required for analysis of aerodynamic, thermodynamic and propulsion data;
- outline and supervise structural tests required to prove the structural integrity of missiles;
- control structural integrity at both test and manufacturing levels.

Assignments are of a most advanced nature. Creativity and the ability to exercise individual initiative are essential to fill positions open on Lockheed's Sunnyvale, Van Nuys and Palo Alto Staffs. Engineers possessing these attributes are invited to write the Research and Development Staff, Sunnyvale 24, or Van Nuys 12, California.

Lockheed

MISSILE SYSTEMS DIVISION

LOCKHEED AIRCRAFT CORPORATION

SUNNYVALE, PALO ALTO, VAN NUYS

CALIFORNIA

RESEARCH ENGINEERS

Research organization has challenging positions open in the Structures Section. We require men with B.S. to Ph.D. degrees in Civil Engineering or Mechanical Engineering and experience or interest in the field of analysis of structures. These positions offer an opportunity to work on a wide variety of problems in small project groups in an intimate environment with some of the leading engineers in this field.

Excellent employee benefits including tuition free graduate study and a liberal vacation policy. Please send resume to:

E. P. Bloch

ARMOUR RESEARCH FOUNDATION

of

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10 West 35th Street
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Do you have an inventive streak?

Like to work on the development of

AUTOMATIC PACKAGING MACHINERY?

Here may be your chance to establish your career in a company whose record is one of steady growth.

Graduate mechanical engineers are needed at Procter & Gamble's modern laboratories just outside Cincinnati to develop new packaging machinery. Here you will find:

- *Salary comparable with the best in industry.*
- *Opportunity to advance in a growing activity.*
- *Job security plus excellent employee benefits.*

If you have been out of college less than 10 years and would like to find out more about opportunities at P & G, please send a brief account of your education and work experience to:

Dr. G. L. Foote
Technical Employment, B-1
Research and Development
PROCTER & GAMBLE
Cincinnati 17, Ohio

FOR THE PROFESSIONAL **Engineer . . .**

A FUTURE IN JET ENGINES AT GENERAL ELECTRIC

The Jet Engine Department at our Evendale Plant in suburban Cincinnati offers qualified engineers excellent positions in the design and development of advanced propulsion systems. Openings are in these and other fields:

TURBINE AERODYNAMIC DEVELOPMENT
Mechanical design responsibilities of turbine structures and components. Work includes planning and execution of programs to meet advanced design objectives.

THERMODYNAMIC CYCLE ANALYSIS
Initiate, develop and carry out programs of cycle performance analysis to improve existing engines . . . provide estimates resulting from engine modification.

COMPRESSOR MECHANICAL DESIGN
Responsible for the mechanical design of components . . . solve specialized problems arising in the design of compressors.

AUGMENTATION DEVELOPMENT
Perform development evaluation on advanced engines . . . conduct tests of advanced design components.

COMBUSTION DESIGN
Thermodynamic design and development of augmentation systems and components. Plan and conduct analytical and experimental programs for the design of specific augmentor systems.

TEST DEVICES DESIGN
Initiate and co-ordinate analytical and test programs to provide engine design criteria . . . design test facilities for turbo jet engine components in simulated flight conditions.

ENGINE STRUCTURES DESIGN
Mechanical design and development of assigned components for experimental, prototype and production engines.

★ *POSITIONS ARE AT ALL LEVELS, INCLUDING SUPERVISORY.*

NEW AND ADVANCED JET ENGINE PROJECTS at General Electric now make it possible for our engineers to pursue their professional aspirations to the highest degree. Presently, we are designing growth versions of the J-79 engine, and we are actively engaged in a new engine project. We are also designing propulsion systems for commercial aircraft. Further, nuclear applications studies are being undertaken . . . and these are just some of the most prominent of our current activities. All of this . . . plus a substantial employee benefit program . . . gives the General Electric engineer the security he's looking for, plus the opportunity to advance his professional talents and build his career.

Send us a resume, or if you prefer, phone us collect. Address . . .

MR. J. A. McGOVERN, PROFESSIONAL PLACEMENT
JET ENGINE DEPT. BUILDING 501 – ROOM A-68 – POPLAR 1-1100

GENERAL ELECTRIC

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Check the following openings at any of these three locations

PHILADELPHIA, PA.

MECHANICAL ENGINEERS (ELECTRO) – Development of computer input-output devices and servo-mechanisms. Research and development work in the field of small, high-speed, electrically-actuated mechanisms where ultra-reliability is a must. Send complete resumé to Mr. James Drumm, Dept. PA-4, 1900 W. Allegheny Ave., Philadelphia, Pa.

SO. NORWALK, CONN.

MECHANICAL ENGINEERS: Graduates BS and MS levels. For development of automation instruments . . . computer input and output mechanisms . . . memory devices. Includes paper and magnetic tape-handling equipment, punched card equipment, printer, magnetic storage drums, and machine design in mechanical and electro-mechanical fields. Send complete resumé to Mr. Robert Martin, Dept. NA-4, Wilson Ave., South Norwalk, Conn.

ST. PAUL, MINN.

MECHANICAL ENGINEERS: For development engineering work in computer input mechanisms consisting of cards, tapes and keyboard devices and high-speed output printing mechanisms. Will design cabinet structures, component packaging, cooling and ventilating systems and miniaturized components. Send complete resumé to Mr. R. K. Patterson, Dept. SA-4, Univac Park, St. Paul 16, Minn.

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ENGINEERS

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Interested applicants may send resume to Mr. P. C. Perry, Professional Employment Co-ordinator. All inquiries will be treated on a confidential basis.

EMPLOYMENT DIVISION
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Expanding and diversified organization has permanent and interesting openings for top-level QC Engineers and Managers at several locations. Please submit complete details of education, experience, and earnings in confidence to:

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Spencer seeks a man with enthusiasm, drive, and a desire for future progress in plastics sales or technical assignment. Plastics processing experience and/or sales experience desirable but not necessary. Location would be east coast or mid-west. Excellent opportunity for future advancement exists in a rapidly expanding organization where annual sales have reached $45 million. Please send resume of your experience to:

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Use a CLASSIFIED ADVERTISEMENT *for Quick Results*

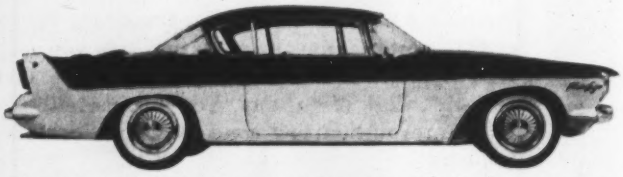
Idea company needs idea men—

This can be the break you've waited for

As Chrysler Corporation looks to the future, it needs men who do the same; men whose "forward look" is toward greater, more rewarding careers. Men whose ability is equal to the opportunity.

As you'd expect, engineers who create the Chrysler Corporation tomorrow find valuable "extras" in careers with the industry leader. For example—

- **top people to work with**
- **flexibility and freedom**
- **good pay**
- **fine opportunities to get ahead**
- **extra rewards for the outstanding job**
- **chance to study at the Chrysler Institute of Engineering and other graduate programs**
- **opportunity to learn from the recognized authorities in the field**



Idea cars, like the "Flight Sweep II" shown here, offer evidence of the way Chrysler designs its future with continuing industry leadership in mind. Chrysler needs—and respects—the creative engineer.

Writing a letter today could be the turning point of your career. If you're a sound, creative engineer with something to add to the Chrysler team, let us hear from you. Write Mr. L. C. Bettega, Technical Personnel Recruitment, Chrysler Corporation, Engineering Division, P. O. Box 1118, Detroit 31, Michigan.

CHRYSLER Corporation
ENGINEERING Division
P. O. BOX 1118 • DETROIT 31, MICHIGAN

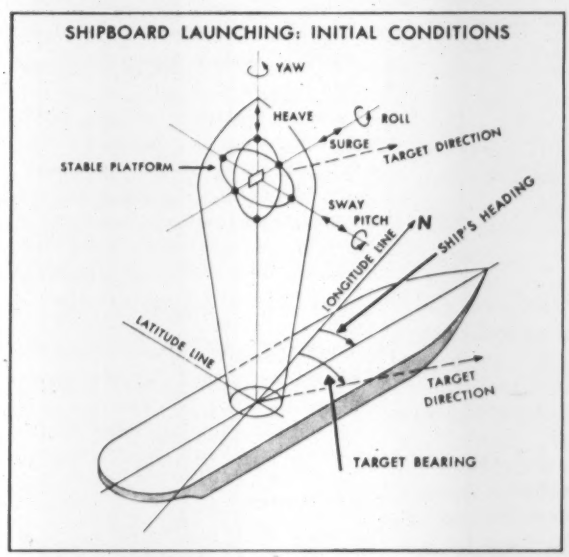
ENGINEERS—SCIENTISTS

GENERAL ELECTRIC SELECTED TO DEVELOP GUIDANCE AND FIRE CONTROL SYSTEMS FOR NEW NAVY MISSILE, POLARIS

New Group Forming as Missile & Ordnance Systems Department of G.E. Adds Navy Project to Nose Cone Development Program.

POLARIS is the most challenging development undertaken by industry for the Navy since the nuclear propulsion program. It is an Intermediate Range Ballistic Missile, whose specifications call for launching capability from both surface vessels and submarines.

PROBLEMS UNIQUE IN MISSILE TECHNOLOGY



The diagram above presents the primary parameters involved in shipboard launching of a ballistic missile in its simplest form.

For Polaris, MOSD must not only surmount these initial conditions but solve fire control problems more complex than heretofore encountered. Pinpoint accuracy in missile guidance is an impressive accomplishment under the most favorable conditions. But how do you achieve it with a missile hurled from a moving platform and aimed at an object approximately 1,500 nautical miles away?

In addition, the Polaris guidance and fire control systems must also operate effectively under the difficult conditions created by submarine launching.

HOW IS MOSD EQUIPPED TO SOLVE THESE PROBLEMS?

As prime contractor for IRBM and ICBM Nose Cone Development, MOSD can draw on a reservoir of top level experience and skill. This G-E department also has a backlog of significant experience in the development and manufacture of Naval Fire Control Equipment, such as range-finders, computers and radar antennas.

NEW OPPORTUNITIES FOR ENGINEERS WITH EXPERIENCE IN THE DEVELOPMENT OF GUIDANCE & FIRE CONTROL SYSTEMS

A new group is now being formed to work on Polaris Missile Sub-Systems at MOSD. It will be located at Pittsfield, Mass. in the heart of the Berkshire resort and vacation area. Openings are at all levels for men with experience in:

GUIDANCE & ELECTRO-MECHANICAL COMPONENTS

Design, evaluation of guidance and fire control equipment

Design, development of electro-mechanical components and servomechanisms

Design, development, evaluation of inertial components, synchros, pick-offs, accelerometers, stable platforms, platform gimbals, verticals, etc.

Design, development, fabrication of analog computers for guidance and fire control systems

GUIDANCE & CONTROL SYSTEMS

Mathematical analysis, feasibility study of control systems and techniques

Synthesis, design, evaluation of guidance and fire control systems

Laboratory development, testing, modification of control systems

ELECTRICAL & ELECTRONIC COMPONENTS

Development of amplifiers and associated circuitry

Development, packing of electronic, magnetic, transistor servo type circuits and components

Reliability, evaluation, analysis of electronic circuits and components

Design, development of fire control consoles

Systems integration, design of electrical and electronic components

Development of electronic and solid state devices, semi-conductors, new transistor applications

OPPORTUNITIES OPEN ON OTHER MISSILE PROGRAMS

Engineers and Scientists with experience in other areas of Electrical Engineering, Aeronautical Engineering, Aerodynamics, Mechanical Engineering, Physics or Mathematics should inquire about positions on other missile programs at Missile and Ordnance Systems Department.

AN INVITATION

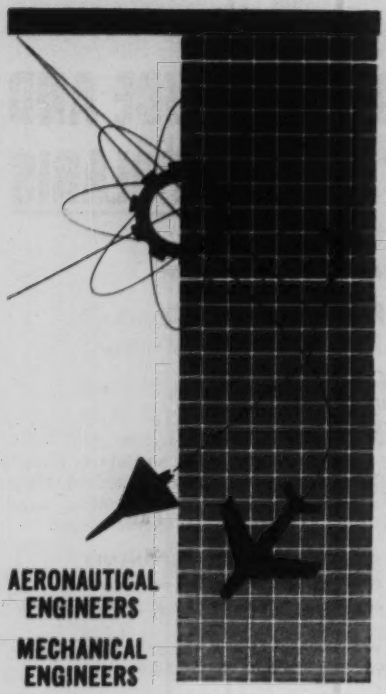
If you would like to contribute to any of the advanced missile development programs at MOSD, you are invited to send a resume of your education and experience. Or write us for a convenient application form. All resumes will be carefully reviewed by the MANAGERS *of our various technical components. You will be invited to visit our offices and discuss work we are doing directly with the Manager with whom you will be working. Communications will be entirely confidential.*

Please send resume to Mr. John Watt, Room S 5-11

MISSILE & ORDNANCE SYSTEMS DEPARTMENT

GENERAL ELECTRIC

1617 Pennsylvania Blvd., Philadelphia 3, Penna.



AERONAUTICAL ENGINEERS

MECHANICAL ENGINEERS

for

ANALYSIS SYNTHESIS EVALUATION

of AIRCRAFT NUCLEAR PROPULSION SYSTEMS at GENERAL ELECTRIC

You will work on the application of nuclear propulsion systems to both manned aircraft and missile systems. The work involves liaison with planning groups in the Atomic Energy Commission, military services, and aircraft companies.

BOTH TECHNICAL AND SUPERVISORY POSITIONS OPEN

Individual advancement aided by Full Tuition Refund Plan for graduate study leading to an M.S. degree, and in-plant courses in nucleonics.

CHOICE OF TWO LOCATIONS:
Cincinnati, Ohio & Idaho Falls, Idaho

Your resume will enable us to determine if you are qualified now for General Electric's nuclear flight development program. All inquiries held in strict confidence.

Please write to location you prefer:

J. R. Rosselot — P. O. Box 132 — Cincinnati, Ohio
L. A. Munther — P. O. Box 535 — Idaho Falls, Iowa

GENERAL ELECTRIC

The GENERAL *Idea*

ON ENGINEERING CAREERS

GENERAL SYSTEM

Your job: find the one in 60 million

Direct distance dialing is the telephone industry's term for the comparatively recent introduction of dialing your long distance calls direct, instead of placing them through an operator.

Many electro-mechanical engineers at General Telephone Laboratories are working on the intricate and fascinating problems that continually arise in this particular phase of telephony.

To get an idea of the complexity of these projects, try to picture the telephone network of this country as a single, integrated machine consisting of about 60 million telephones. Then consider the task of connecting any one of these telephones to any other simply by dialing from ten to thirteen digits, instead of the conventional seven digits for local calls.

Remember that the connection must be made as quickly as it is in dialing your next door neighbor — and, of course, with the unfailing accuracy the public takes for granted in their dial telephone. Now you begin to comprehend the complex circuitry and high-speed switching that are the province of the telephone engineer.

Although direct distance dialing is a reality of some years standing in many parts of the country, not all the problems have been threshed out by a long shot. New detection methods are being investigated. Systems that work faster and take less space are the constant goal. And, as with every innovation in telephony, the problem of converting existing systems to handle the latest miracle is the telephone engineer's never-ending challenge.

The dial — automation's granddaddy

While the telephone industry did not invent the term automation, it did invent most of the processes and products that have made automation possible.

Filming high-speed rotary switches to study operations in slow motion.

For instance, the invention of the dial telephone by Automatic Electric engineers (that was 1892, believe it or not) led directly to automated assembly lines, automatic pin spotters, digital computers . . . you name it.

Automatic Electric is one of our affiliated manufacturing companies in the General Telephone System. For generations it has been a leading source of control components for industry as well as the principal equipment manufacturer for independent (non-Bell) telephone companies. And General Telephone Laboratories provide R&D support for the entire sphere of Automatic Electric's widely diversified manufacturing operations and for all of the other manufacturing and telephone operating companies in the General Telephone System.

You're invited . . .

The tremendous growth in the communications industry specifically and in the application of automation principles in general have created many stimulating new engineering opportunities here at General Telephone Laboratories. We're interested in you if you are qualified for important research and development work in electronics, electrical, electromechanical or mechanical engineering, or physics.

We can be much more specific about your particular career destinations if you will write directly to Mr. Robert Wopat, president, General Telephone Laboratories, Northlake, Illinois.

GENERAL TELEPHONE LABORATORIES
INCORPORATED
NORTHLAKE, ILLINOIS

A member of the General Telephone System—One of America's great communications systems

INDUSTRIAL ENGINEERS

$6000 – $8000

Opportunities in plant layout, material handling, equipment utilization, manufacturing methods and systems, capital improvement projects. Degree in I.E. or M.E. Experienced or recent grads. Multiplant company. Employer pays our fee and expenses. Send resume and photo to Mr. H. A. Jensen.

Walker Employment Service
212 South 7th Street Minneapolis 2, Minnesota

MECHANICAL ENGINEERS

FOR

the rapidly expanding Texas Division of Dow located on the Gulf Coast. Permanent openings in several categories.

Mechanical and structural design problems and general scale up problems.

Estimators—For new construction and revisions of existing facilities.

Mechanical Design—Calculations and design of new equipment.

Instrumentation Design and Maintenance.

Production of various products.

Please send resume to

J. P. Middleton
Technical Employment Department
THE DOW CHEMICAL COMPANY
Freeport, Texas

Mechanical Engineers and Piping Designers

BECHTEL

Offers you immediate long range engineering opportunity in

New York
or
San Francisco

Engineers and piping designers with Steam Electric Generating Station, Refinery, or Process Plant experience will qualify.

Send Resume to
Manager of Employment & Placement
Industrial Relations Division

BECHTEL
CORPORATION
220 Bush Street
San Francisco 4, Calif.

For your convenience, recruiting offices are also located in:
New York and Houston

...John answered a Librascope ad for DIGITAL COMPUTER ENGINEERS, and we're moving to Southern California in three weeks! Out there, opportunities in John's field of LOGICAL DESIGN are terrific. John likes the project team approach at Librascope . . . he's finally going to have a chance to follow through on his project . . . and he will have full cooperation from management. "Say . . . your husband is an ANALOG COMPUTER man; why don't you mention Librascope to him? Tell him to write: Glen Seltzer, Employment Manager—808 Western Avenue—Glendale, California. They need men with his experience."

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COMPUTERS · CONTROLS · COMPONENTS
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POSITIONS OPEN

Continued from page 145

VALVE AND NUCLEAR ENGINEERS

Aggressive Research and Development activities have made Edward Valves, Inc., a leader in the steel valve industry.

We have expanded our Research facilities to maintain this position.

Openings are for Engineers (mechanical, stress, flow, materials, metallurgists) interested in design and development of valves for high pressure, high temperature service and nuclear power applications. Replies are confidential.

EDWARD VALVES, Inc.
Subsidiary of the Rockwell Manufacturing Company
1200 West 145th Street, East Chicago, Indiana
Mr. E. A. Looser, Engineering Personnel

MECHANICAL ENGINEER

Graduate mechanical engineer in power plant design work. Experience not required. Excellent opportunity with consulting engineering firm in the Middle West. Liberal benefit plans and good working conditions.

Send resume of education and experience with statement of salary requirements.

Address CA-5905, % "Mechanical Engineering."

TEACHING POSITION available in mechanical engineering. Interest in materials, and machine design courses desirable but not essential. Assistant Professor rank. M.S. degree preferred. Apply: Executive Dean, Fresno State College, Fresno, California.

TWO POSITIONS TEACHING in Mechanical Engineering Department. Master's degree preferred. Salary depends upon training and experience. Positions open September 15 or later. Address Prof. A. P. Young, Michigan College of Mining and Technology, Houghton, Michigan.

TWO TEACHERS—Mechanics, Applied Electricity, General Physics. One Head of Department, Ph.D. Engineering preferred. B.S. or M.S. also considered. Salary and rank dependent on qualifications. Salary scale good. Room for advancement. Apply President, Montana School of Mines, Butte, Montana.

MECHANICAL and STRUCTURAL DESIGN ENGINEERS and DRAFTSMAN for plant layout work and automatic equipment. Work involves board work and some field work. Experience in pulp or paper mill helpful but not essential. Location South. Good opportunity for desirable applicants. Give experience and salary range with application. Address CA-6248, care of "Mechanical Engineering."

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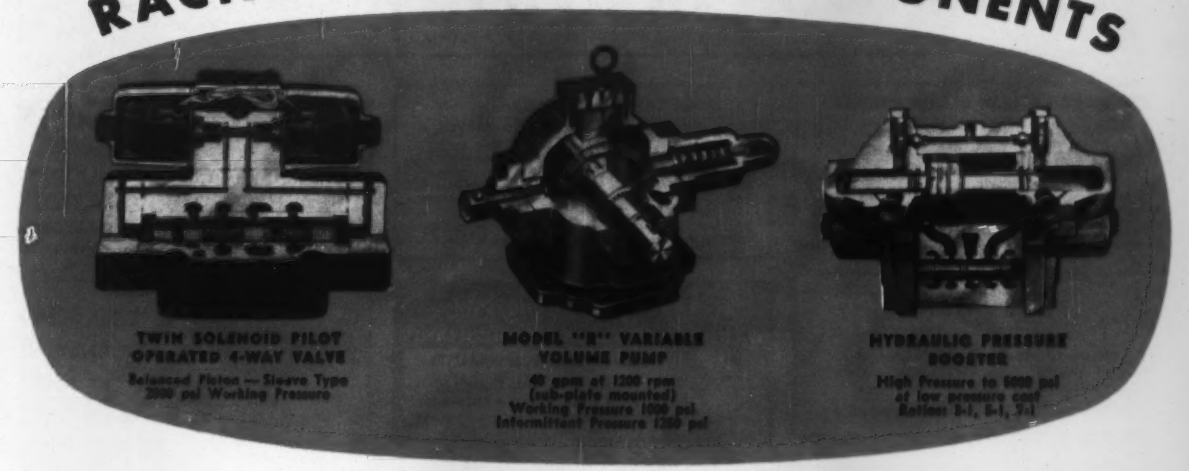

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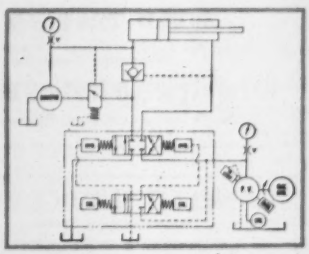

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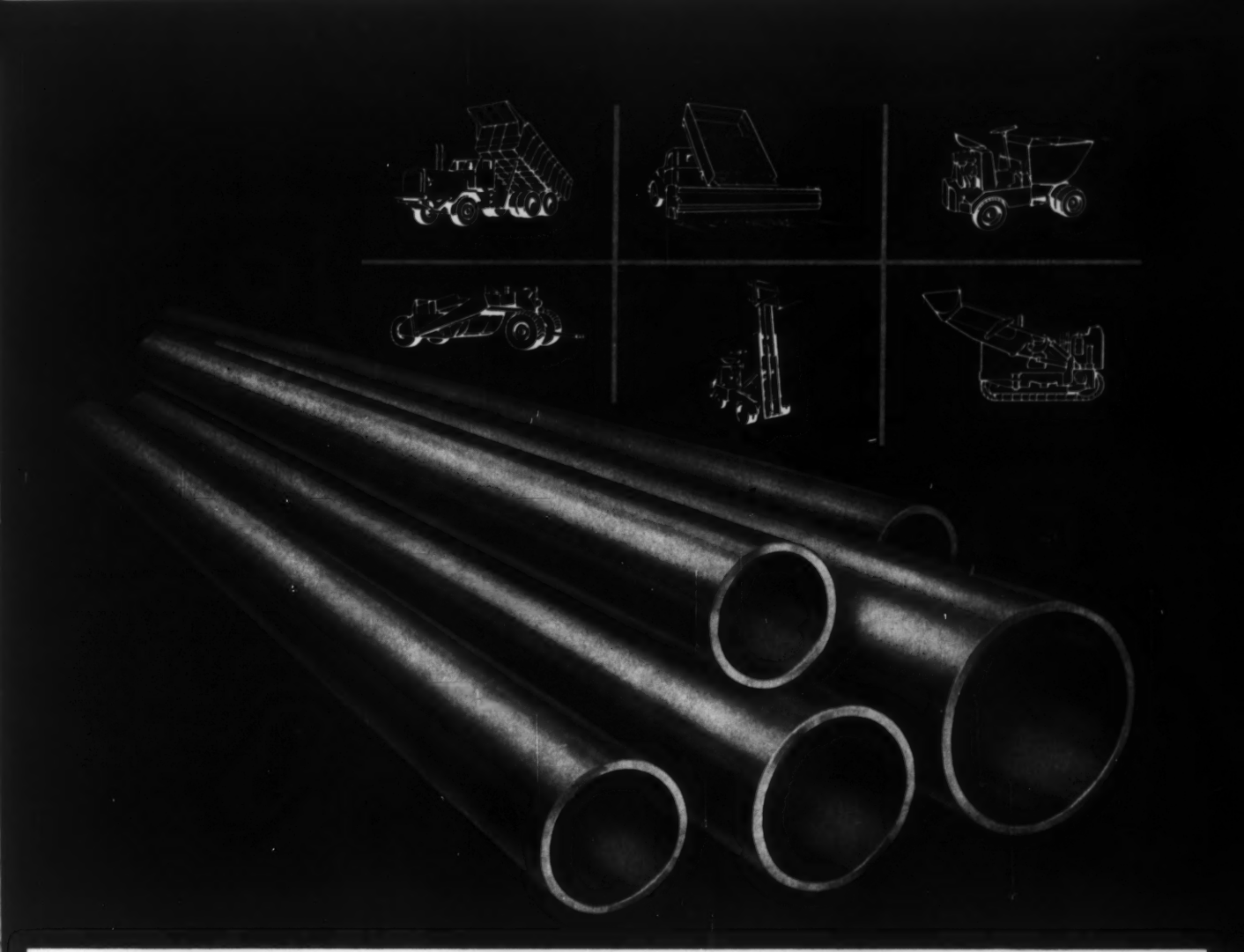

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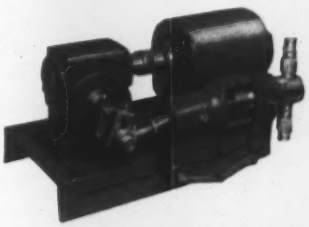

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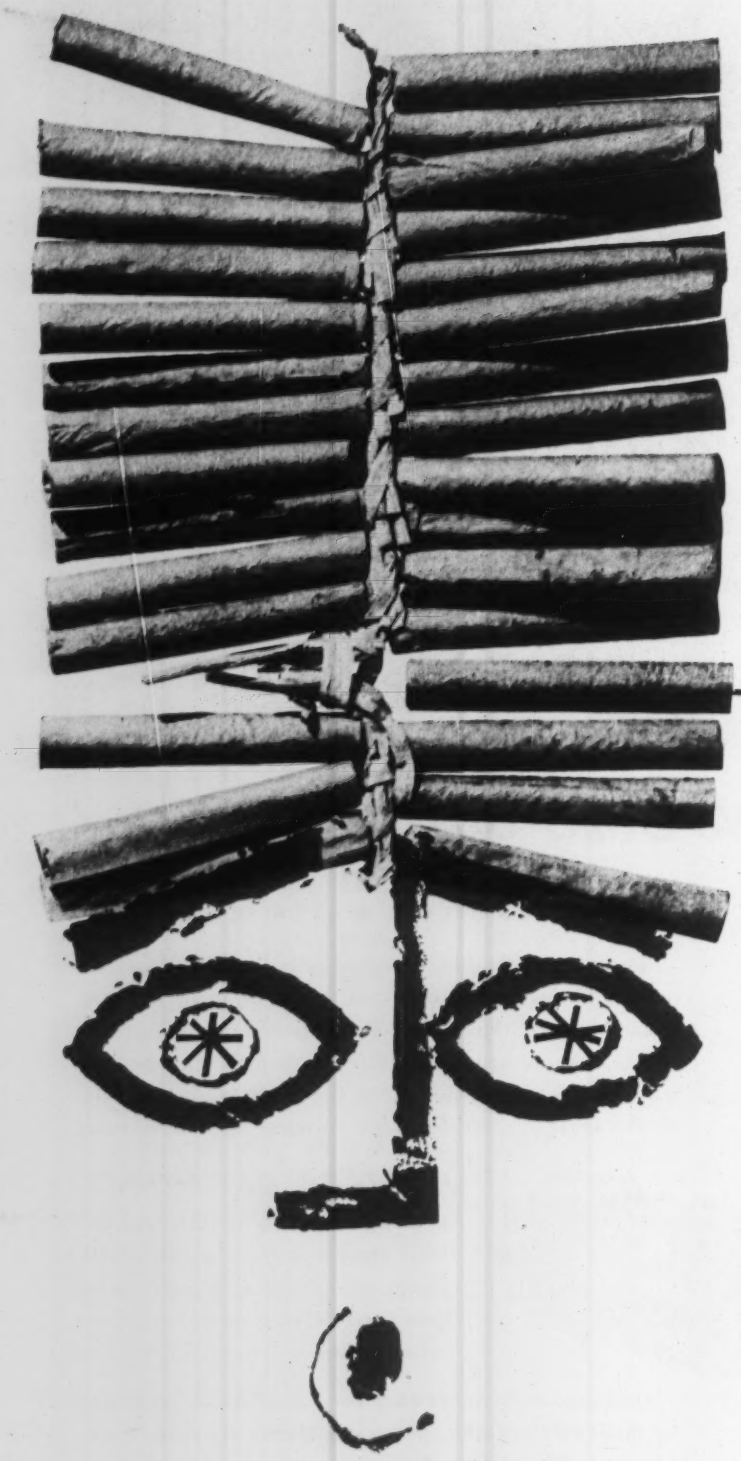

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The challenge is exciting. In Los Angeles, our major effort is the continuing development program for the Army's Corporal. In Monterey – Carmel-by-the-Sea, our new Engineering Lab is also blazing trails in guided missile and related fields. And don't discount this big dividend: while your career is going up, your family (and you) will enjoy living it up in California!

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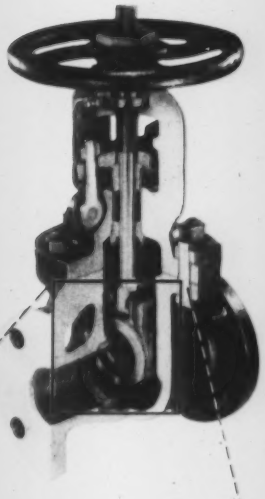
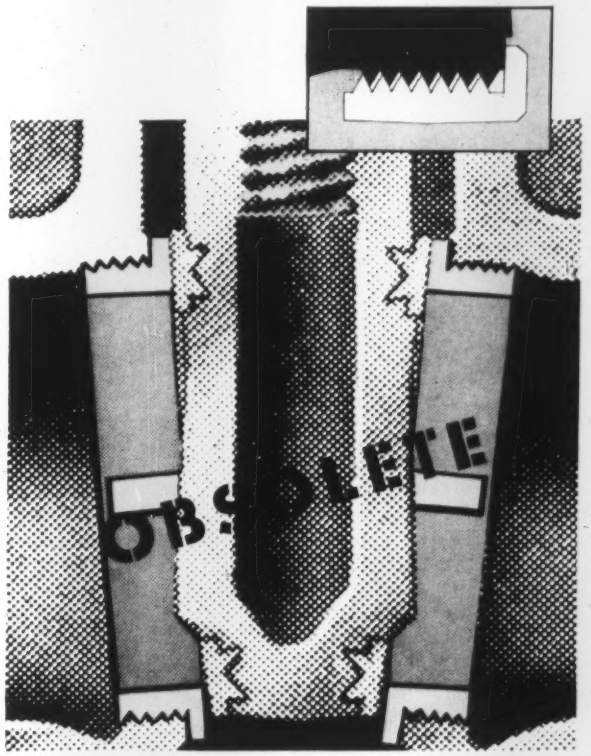
ARE YOUR TRIM SPECS UP TO DATE?

Put an end to iron valve seat ring and stem-wedge problems. Make sure your specifications call for modern, trouble-free OIC end-seated seat rings and T-head stems.

There is no extra cost and yet this superior design will reduce your maintenance overhead many times.

For specification details write for OIC Iron Valve Bulletin No. 1005. The Ohio Injector Co., Wadsworth, Ohio.

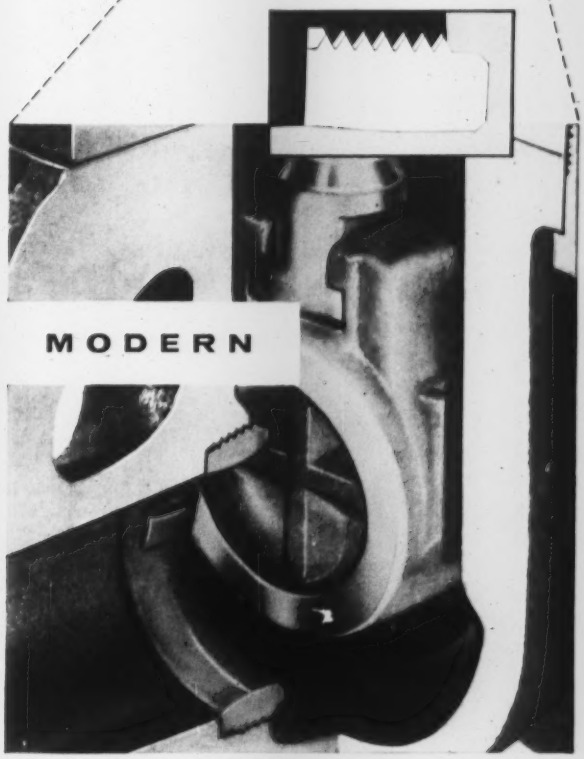




Shoulder-seated rings
Screwed stem-wedge connection

Ring design causes turbulence. Open back of ring is easily eroded. Ring is seated in tension. Continuous operation compresses and tends to loosen it, developing serious leaks.

A screwed stem-wedge connection is rigid. Closing valve under pressure tends to bind wedge, make closing difficult and perhaps bend the stem.

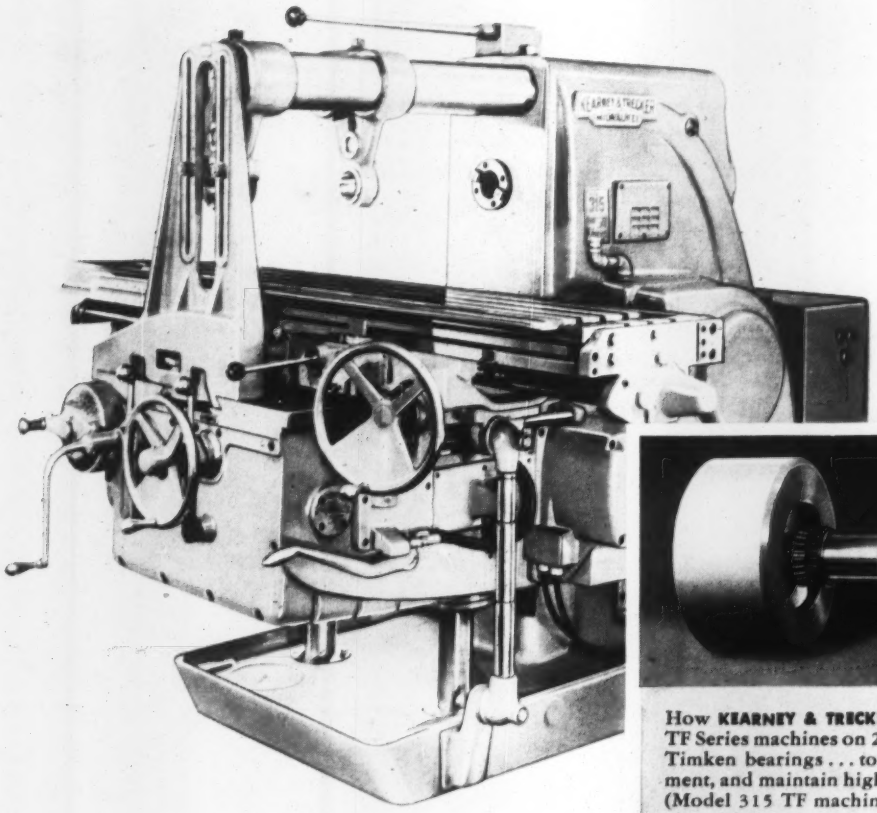


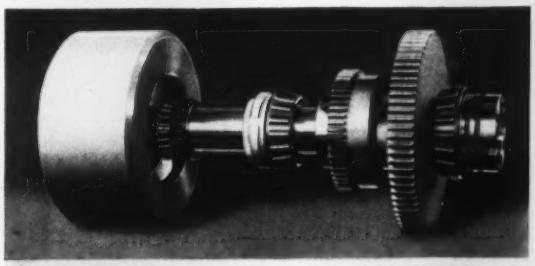
OIC end-seated rings
T-head, stem-wedge connection

Streamlined flow-through. No pockets open to attack by erosion. Ring is seated in compression. Stays tight even in continuous operation.

T-head stem-wedge connection is flexible. Wedge can't bind. Closing is easy and stem is unaffected.

OIC VALVES | FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON VALVES





How **KEARNEY & TRECKER** mounts the spindle of its TF Series machines on 2 single-row and 1 double-row Timken bearings . . . to hold spindle in rigid alignment, and maintain high accuracy through 24 speeds. (Model 315 TF machine illustrated).

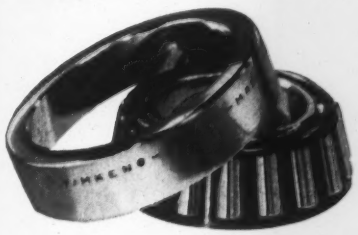
New milling machine gets constant accuracy through 24 speeds with spindle on TIMKEN® bearings

FROM 15 to 1500 rpm, with 24 speed changes in all, and plenty of capacity for any tool load—that's the new TF Series of twin-screw designed Kearney & Trecker mills. There are 28 Timken® bearings contributing to these machines' built-in stamina and constant high precision. Most importantly, the spindle is mounted on two single-row and one double-row Timken precision bearings which hold it in rigid alignment through all speed and load changes. Chatter is eliminated, and long bearing life with minimum maintenance is assured.

Because of their tapered design, Timken bearings take radial and thrust loads in any combination. Full line contact between rollers and races imparts extra load-carrying capacity. And of course, with Timken bearings designed to last as long as the machine itself, maintenance costs go down.

Geometrically designed to give true rolling motion, Timken bearings are precision manufactured to live up to their design—produced under rigid inspection and quality control. We even make our own fine alloy steel, something done by no other American bearing manufacturer. When you build or buy equipment, look for the "TIMKEN" trade-mark on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



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